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QUARTERLY

OF THE

National Fire Protection Association

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87 MILK STREET, BOSTON, MASS.

EDITED BY THE SECRETARY

National Fire Protection Association.

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Western Sprinklered Risk Association.
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Reports on fires appearing in the Quarterly are copies of or extracts from written reports forwarded to the Association. This Association, as a body, is not responsible for the statements or opinions of any of its members.

THE PRIZE FOOL

THERE ARE FOOLS AND FOOLS, BUT THE PRIZE FOOL IS THIS ONE.

From *Puck*. Copyright, 1912, by permission.

Every time you light a match you start a fire. Be sure that you put it out.—Henry H. Hickok.

The Quarterly

Vol. 5 April, 1912 No. 4

The Coming Annual Meeting. The time of the Sixteenth Annual Meeting, Tuesday, Wednesday and Thursday, May 14th, 15th and 16th, will be but a fortnight off when this issue of THE QUARTERLY reaches the membership. The principal difficulty that has always confronted the program committee is the selection of an assembly hall that is neither too small nor too large. Last year the great ballroom of the Waldorf-Astoria was too large, and the year before at Chicago the ballroom of the Hotel La Salle was much larger than our needs required.

We are to be especially favored in the matter of a meeting room this year, owing to the completion of Chicago's new Insurance Exchange building, to be ready for occupancy May 1st. The beautiful new auditorium of this building has been placed at our disposal for the three days of our meeting. This will afford us accommodations that will take care of our large attendance at the opening exercises, without leaving us stranded upon an echoing acre of floor space for the discussion of our committee reports. These reports, while they do not always engage the attention of our guests and casual visitors, represent the engineering functions of our Association. They are of vital interest to the representatives of our active members and especially helpful to the large number of young engineers and inspectors who look forward to our annual meeting as an educational opportunity. The pleasure and comfort of the engineering sessions are immeasurably increased by placing them in a room of such dimensions that an ordinary voice can easily be heard in it.

The committee has planned an innovation this year in the arrangement of the program. The President's address and the reports of the officers are to occupy the first morning session, and all the public addresses are to be put into the afternoon of the first day. The committee reports and technical addresses will be reserved for Wednesday and Thursday, the second and third days of the session. It is believed that in a compact audience chamber the committee reports can be much more expeditiously rendered so that

no difficulty will be experienced in getting through the list and the discussions thereon early enough on Thursday afternoon to permit the usual visit to the Underwriters' Laboratories which is being planned for by Manager Merrill.

* * * * *

What Two Philadelphia Members Did.

One of the most striking and valuable forms of public service ever rendered by members of the Association is that recently given to the city of Philadelphia by two of our Philadelphia members, Mr. Chas. A. Hexamer and Mr. Powell Evans, in co-operation with the local director of the Bureau of Municipal Research, Mr. Jesse D. Burks. These gentlemen accepted as a special committee the responsibilities placed upon them by the director of the Department of Public Safety in the preparation of a preliminary report on fire protection and fire prevention for the city of Philadelphia.

One of the commonest, although most deplorable, facts which face the student of municipal problems is the lack of mutual co-operation and understanding among the various municipal departments of a great city. It was owing to such conditions in New York city, where progress was practically blocked through inability to place responsibility upon any single department, that the Bureau of Fire Prevention was devised. The report of the committee above referred to reveals a similar situation in Philadelphia. It points out the fact that the city fire marshal takes much too limited a view of his responsibilities, and that many of the city ordinances, for example that regarding the storage of gasolene, are obsolete and require prompt revision. The report, although claiming to be merely preliminary, seems to us a very thorough and comprehensive document. It first outlines the agencies and what they are expected to do under the present laws. It then very carefully recites what the agencies in question actually do, and concludes with suggestions as to what they might do. The principal weakness of the Philadelphia situation as suggested in the report lies in the fire marshal's department and the fact that no inspections of buildings are made during occupancy. The report also points out that the water pressure in Philadelphia is insufficient and that the annual daily use of water is 200 gallons per capita—an astonishingly wasteful figure. The report concludes with the recommendation that the mayor be requested to appoint a commission to ascertain the facts and to submit a constructive program for increasing the efficiency of the several public agencies concerned and for bringing about correlation between the different agencies and between them and private agencies performing related functions.

The suggestions of this committee, upon which our members have rendered such distinguished service, might well be adopted by every large city in the Union. It is a movement in the direction of efficiency in the administration of one of the most vital functions of the municipal government. No comprehensive or effective work can be done in fire prevention in any large city until the various departments are brought into harmonious relation.

The Equitable Building Fire. Through the courtesy of our active member, the New York Board of Fire Underwriters, we are enabled to present in this issue the admirably complete report on the fire in the Equitable Building, prepared with such painstaking care by Supt. F. J. T. Stewart and his assistants, Messrs. W. C. Zabriskie and G. Y. Lancaster. Mr. Zabriskie and Mr. Lancaster have for some time specialized in fireproof construction and hydraulics, and these gentlemen gave to this report their undivided attention for about thirty days. Mr. Stewart himself devoted ten days to the work.

The prime object in the investigation and framing of the report was to utilize the costly experience gained by this fire and turn it to the best possible advantage in connection with safeguarding life and property hereafter.

The investigation was delayed by the exceptional severity of the winter weather and the dangerous condition of many parts of the building for some time after the fire. Free access to some portions of the building was also denied at times during the removal of the unusually valuable securities contained in the vaults and safes.

The printing of this unusually complete report in THE QUARTERLY puts in permanent form some very valuable data and constitutes a very important addition to the fire records of the Association.

* * * * *

The Skyscraper in New York. If the various lessons of the Equitable fire are not turned to practical advantage it will not be the fault of the New York press. Impressed especially by the fact that this fire in a single building prevented access to a billion dollars of securities and seriously impeded financial operations, the *New York Times* in considering "the skyscraper problem" points out that if New York is to have these lofty buildings it is vitally necessary to distribute "the organs of business among them in such a manner that a conflagration cannot overcome several of them at once." Although the Equitable building was not so much a skyscraper itself as the parent of the brood, the *Times* raises these pertinent questions:—

> A skyscraper extends into the air almost the front of two blocks, and quite that distance if over-all figures are taken. Can it be wondered that all the owners of that neighborhood are envious, and is it true that the owner of the skyscraper entitles himself to thrive so much at his neighbor's expense by his nerve in using his own capital or in borrowing other people's money for that use? And if he has such a right, ought it not to be restrained in the public interest, in consideration of the public problems which are raised by the exercise of the right? Our streets and our sewers are not designed or adequate for the burden thrown upon them. We built our skyscrapers because our transit facilities were so bad, and we are now driven to spend hundreds of millions to increase the transit facilities necessitated by the skyscrapers. Where is this to end?

Although it has been tardy there has clearly come within the past few years a gradual awakening to the problems, difficulties and dangers brought about in New York by the construction of building after building without

restriction to height. It is possible that the destruction of the Equitable building in dramatically directing public attention to these things will cause such a crystalization of sentiment as to result in definite action. If this should be the fortunate outcome, to the Equitable building will belong the unique distinction of having both inaugurated and limited the development of the skyscraper.

* * * * *

The Wooden Shingle Again. Commenting upon the Houston fire, the *Dallas News* which has been especially helpful in the Association's fire prevention campaign in Texas, remarks :—

> The shingle roof gives to every fire the possibilities of conflagration. When there is a high wind, such as seems to have prevailed at Houston Wednesday morning, the shingle roof gives to every fire not merely the possibilities but the probabilities of a conflagration.

As a text in non-progressiveness concerning a very practical matter, this antiquity of the shingle roof is thought provoking. Never has there been a serious conflagration that covered any considerable area, in any city, but the shingle roof figured as a most active agency in spreading the flames. This is not due altogether to the fact that the shingle roof is no protection to the building on which it is placed. Just the statement of that fact is sufficient. But burning shingles in a high wind become flying torches. They act as so many incendiaries, and no fire department ever organized is competent to fight effectively against them.

Fire prevention, so far as it has become a science, has not yet properly concerned itself with this menace that is widespread in every city. We have done a great deal and at great expense toward making the best business property fireproof; but very often much of that work is rendered useless by the shingle roof that is put over the residence property or the lesser business property. A fire starts in some congested district where this sort of roof prevails, as was the case at Houston; there happens to be a high wind blowing and the burning shingle roof soon does the rest. Baffling all human efforts, the fire gathers headway and is carried to other parts of the city, and the next morning we read of the destruction of millions of property that might have been saved if there had only been provided a proper fireproof covering for the buildings on which shingles were used, and the municipality had compelled its adoption.

For civic progress to turn its attention to the shingle roof is a matter of practical moment.

* * * * *

Fire Hazard of Clothes Closets. Recent correspondence on the subject of the fire hazard of *clothes closets in finishing shops* has developed the fact that the Association has never given attention to a standard for the construction of such closets. Our active member the Canadian Fire Underwriters' Association has recently given thought to this subject and has suggested the following specifications :—

Clothes closets for painters and finishers' oily clothing (overalls, aprons, etc.) to be entirely of iron or steel; the top, bottom, back and sides to be solid and not less than one sixteenth of an inch thick, the front to be of the same material for 8 inches from the bottom, and the door, which must be of open mesh wire for ventilation purposes, to open above this. To stand on solid legs not less than 8 inches in height, and not to be put against a wall unless it is of solid brick, stone or concrete and without combustible lining.

The subject, notwithstanding its importance, is not susceptible of any very extensive rules or requirements. Our member seems to have covered it pretty thoroughly in the brief paragraph above quoted. It would seem that observance of the precautions suggested would minimize the hazards of clothes closets.

* * * * *

Coal Oil as a Fire Extinguishing Agent. The following account of the use of coal oil as an extinguishing agent for fire in baled cotton comes "from Missouri":—

It is a well known fact that a bale of ginned cotton is packed and wrapped so tightly that casks of water and chemical extinguishers are of no avail in extinguishing a fire, once it has eaten its way into the bale. In fact a bale may be submerged in water with very little effect. It usually becomes necessary to pick it to pieces.

Lint cotton will only absorb water for a few inches from the outer surface of the bale. The fire, however, usually penetrates to the center and is industriously working its way in several different directions therefrom when first discovered. At this stage, and at this stage only, coal oil is said to be the only known agent that will penetrate to the seat of the trouble. When poured into the slightest crevice of the bale, it is slowly, but surely, absorbed by the lint cotton contained therein. After reaching the fire itself, it will, if carefully and persistently applied, finally smother it. This result is said to be accomplished without greatly impairing the commercial value of the unburned portion of the bale. Our correspondent states that "it is not the usual custom to keep oil around the gin, for the fire burns so slowly that it can ordinarily be obtained after the fire has been discovered, if, as a last resort, it is desirable to try the oil treatment."

* * * * *

Thread Pitch Gages for Hydrant and Hose Couplings. At the last annual meeting the report of the Committee on Standard Hose Couplings and hydrant fittings contained the recommendation that the Association order a supply of *thread pitch gages* for the use of members in the inspection of hose couplings and hydrant fittings. Considerable difficulty and delay were encountered in locating a manufacturer who was willing to make for us such gages at a reasonable figure. Chairman Griswold has finally succeeded in finding one who, if an order for a sufficient number is placed with him, will manufacture these gages at a figure that will permit us to retail the same at a price of 75 cents each, carriage

paid. Members desiring one or more of these gages should send their order at once to the office of the Association, 87 Milk Street, Boston.

* * * * *

The Laboratories' Branch Office in New York. The announcement that our active member the Underwriters' Laboratories is, after May 1st, to operate a station for testing electrical appliances in New York City in connection with its agency at that point, will be of keen interest to all our members whose work touches electrical engineering. While this station will find its most active use in the service of inspections at factories, it is to be arranged that applications for tests of electrical fittings may be made either to the New York office or the principal office and testing station at Chicago. As three fourths of the manufacturers of electrical appliances are located east of the Allegheny Mountains this new arrangement should find great favor with this fraternity.

Mr. Dana Pierce, electrical engineer, who has been in charge of the electrical department of the Laboratories at the principal office and testing station in Chicago during the past six years, is to locate in New York and assume also the conduct of the agency of the Laboratories in the metropolis. Mr. Pierce's fine abilities and high integrity would suffice to make a venture of almost any magnitude successful. His fellow members of the N. F. P. A. in the east are already congratulating themselves on the prospect of having him among them.

Public Education.

Although study of the colossal figures of the fire waste of the first three months of the current year (nearly a million dollars a day!) does not indicate any striking success in the curtailment of the fire waste, it is perfectly obvious that we are beginning, nationally at last, to make a big noise about it. Not only are the daily papers from one end of the country to the other beginning to analyze and seek responsibility for all important fires, but the last few months have developed an astonishing brood of publications with fire prevention as their object. *Insurance Engineering* has taken on new life and a new editor; the Fire Marshals' Association of America has begun an attractive publication called the *Fire Alarm;* St. Louis has given birth to a magazine called *Conservation;* New York produces another in highly colored covers entitled *The Fireproof Digest;* the *Western Underwriter* has made a special magazine of its fire protection supplement with a heading of "Fire Protection" in good red ink; *The Insurance Field* announces a fire protection supplement; and our active members the Dakota State Fire Prevention Associations have begun publication of a magazine entitled *Fire Prevention.* Four of these publications came into life in January of this year.

It is obvious that these publications, which depend upon advertising and subscriptions from the general public for their revenues, find their initia-

tive in the belief that the American people are now sufficiently awakened to the proportions of the fire waste and its economic significance, and desire sufficient information regarding it, to enable such journalistic ventures to pay their way. In the light of this assumption we may well feel satisfied that our campaign of public education, which seemed so hopeless at its beginning three years ago, has accomplished substantial results.

We must not assume, however, because certain helpful publications are coming into the arena that much progress has been made in really stirring the American people to a comprehension of this great issue. We may find a barometer of the nation's ignorance in the attitude of certain sections of the country toward fire underwriting. The *Commercial and Financial Chronicle* of New York in its issue of March 9th comments upon conditions as it sees them as follows;—

> In general there is discouragingly slight evidence of a better understanding of the nature of underwriting, and it still seems to the ordinary legislator that to attack insurance instead of fire will be a popular course; in answer to the constant call for more public expenditures, insurance is still scrutinized to see whether the leech of tax could not be applied at some new spot. On the other side, however, there is distinct encouragement in the attention now given to prevention campaigns. The States latest announced as fields for this movement are Alabama, Louisiana and Mississippi, and while this movement is, thus far, chiefly among underwriters and certain organizations which are one with them in main purpose, it is significant that the National Association of Credit Men, after giving increasing public attention to this subject during the last two years, lately began a two-months' "speaking tour."
>
> As a straw which shows direction, the February trade letter of the Union National Bank of Louisville remarks, among the topics covered, that the burning of the Equitable Building may be useful in turning public attention to the appalling fire waste. It cites figures of the loss per capita here and in European countries, and says that this is "a great national question that serious business men must think about and act upon."
>
> This conservation movement does not challenge imagination, is not popularly attractive, and will not sweep across the country with the speed of a prairie fire, as various movements against associated capital have done. It has been long delayed and long overdue; it has begun slowly and almost timidly; it gets slight general attention. Yet it has begun because the situation compelled. Its tardiness and its slowness of movement are the surest warrant that it will not halt. It is the most hopeful sign of the current year in this important matter. It means that the country will gradually come to understand that waste is the common public enemy to be fought, and that the agencies which primarily lessen the shock of its injury and also seek to diminish it ought to be honored and fostered rather than made a target for oratory and tax-seizing.

This editor has the acumen to discern that the still prevalent general inclination of legislators to begin to fight the fire waste at the wrong end, is an indication of a wide, deep gulf of public ignorance regarding the incidence of the fire tax, which it will take many "fire protection supplements" indeed to fill up.

The Louisville bank referred to in the editorial is one of the few American banks which are members of the National Fire Protection Association. Its cashier, Mr. F. M. Gettys, is a former President of the

National Association of Credit Men, a fluent and convincing speaker, and a man of fine literary appreciation. He has delivered a number of public addresses upon the fire waste.

* * * * *

The principal work of public education during the last quarter was of course the campaign of the National Association of Credit Men, in which Secretary Wentworth co-operated as a speaker. Mr. Wentworth left New York on January 21st in company with Secretary J. H. Tregoe of the National Association of Credit Men. The latter appeared with Mr. Wentworth as a speaker at the meetings at Buffalo, Cleveland, Grand Rapids, Milwaukee and Minneapolis. At St. Paul the two Secretaries were joined by Mr. Chas. E. Meek, Vice President of the Credit Men's Association and an executive of the National Fire Protection Association. Messrs. Meek, Tregoe and Wentworth appeared together at St. Paul and Duluth. From Duluth Secretary Tregoe returned to New York, Messrs. Wentworth and Meek continuing their tour and speaking together at Fargo, Butte, Spokane, Seattle, Tacoma, Portland, San Francisco, Los Angeles, San Diego, Salt Lake City, Denver, El Paso, Fort Worth, Dallas, San Antonio and Houston. At New Orleans, Messrs. Wentworth and Meek were again joined by Secretary Tregoe who appeared with the travelers at that point and at the meeting in Montgomery. Messrs. Meek and Wentworth continued the trip to New York together, speaking at Birmingham and Knoxville en route.

This campaign, planned by Mr. Meek while yet Secretary of the National Association of Credit Men, represents the most comprehensive work of public education on the fire waste which America has yet witnessed. In June of last year, after having made this plan, Mr. Meek gave up his desk in the office of the National Association of Credit Men and went to the Fourth National Bank of New York as Assistant Cashier. It was due to the large outlook and public spirit of the president of the Fourth National Bank, Mr. J. G. Cannon, that Mr. Meek was enabled to carry out his plan so carefully laid and accompany Secretary Wentworth on his arduous tour. It is doubtful if many bank presidents in America at this time would have permitted an officer of the bank to absent himself from his desk for a period of two months in a fire prevention campaign.

That the value of this work planned by Mr. Meek and executed by himself, Secretary Wentworth and Secretary Tregoe, with the generous and enthusiastic co-operation of the local associations of Credit Men in every city visited, cannot yet be properly estimated, is obvious. Through its instrumentality the proportions and economic significance of the fire waste were brought clearly before the most influential men in all the large Western cities. Governors, mayors, insurance commissioners, fire marshals, fire chiefs, directors of public safety, and officials of boards of trade and commercial clubs were either invited to the dinners in each city or met the fire protectionist visitors at specially arranged luncheons. The newspapers

invariably gave much space both to the character and importance of the mission and printed voluminous reports of the meetings and the addresses of the speakers. In Portland and San Francisco Secretary Wentworth was asked to address the High Schools and spoke to twelve or fifteen hundred pupils at each session. The Electrical Club of Denver arranged a very large noon meeting and the Louisiana Society for the Reduction of the Fire Waste planned for an afternoon meeting at New Orleans. These were in addition to the regular evening meetings arranged by the Credit Men. While the speakers were in Duluth they received a special invitation from the Commercial Club of Superior, Wisconsin, tendered through the Mayor of that city, to address the citizens of Superior at a special noon meeting. Many other meetings along the route were suggested, and asked for, but were not permitted by the itinerary, which gave to the speakers only 60 days in which to complete a journey of more than 11,000 miles.

Taken in connection with the speaking tour arranged by the Credit Men on the Eastern seaboard last season, Messrs. Wentworth and Meek have now spoken on the fire waste in all cities of the country of any considerable size except two. The beneficial results to the cause of fire prevention and the interest created in the subject is indicated by the correspondence which began last year to flood both the offices of the National Fire Protection Association and the National Association of Credit Men before the journey was half completed. Through the interest of the Credit Men, Secretary Wentworth has now added to his acquaintance, available for co-operative work with our Association, numerous active and influential business men in all parts of the country.

It would be impossible to set down within the limits of THE QUARTERLY the interesting incidents of this extended tour. The character of the newspaper notices, where they contained anything more than a formal report of the meeting and printing of the speeches, was usually friendly in its attitude towards Secretary Wentworth and his work. Even in the Northwest in the heart of the lumber-producing section, where Mr. Wentworth took no pains to conceal his hostility to shingle roofs, the newspapers as well as the citizens received his remarks without unfavorable criticism. The following extract from the *Tacoma Tribune* of February 11th is a representative press notice:—

> One of the most interesting speeches that ever was heard in the halls of the Tacoma Commercial Club fell last night from the unsmiling lips of the secretary of the National Fire Protection Association at the dinner given by the Credit Men's Association of this city. For well over an hour a hundred business men listened with strained ears to the placid stream of business sense, unhastening invective, covert sarcasm and brilliant humor, awakening them to the criminal extravagance of which the speaker accused the nation in its relations with fire. Not even when the products of the lumber business were assailed in relation to the subject was there more than a ripple raised and the president of the National Lumber Manufacturers' Association, Major Everett G. Griggs, himself harkened attentively and without challenge to that mordant, but gestureless, apparently unimpassioned address.
>
> Charles Meek, following Mr. Wentworth, traced the connection of the Credit

Men with the Fire Protection Association, showing that the economic value of fire protection as a security for credit appealed to business men. One of the methods adopted is the fire marshal law, which calls upon the fire marshal to hold an enquiry into every fire and endeavor to place the responsibility. These officials also inspect all buildings at all times to see that proper fire precautions are in practice.

The President, George B. Burke, then called upon Hermann von Shrenk, consulting engineer of the lumber trade, who was present, to say something for the assailed shingle. Mr. von Shrenk showed that there was a comparatively large use of wood in Germany, but yet there was nothing like the same fire loss.

The reason for this he attributed to the fact that Germany is slow to waste. The shingle, he declared, has much to recommend it and its fireproofing is not impossible. It will not be driven from the market because of one physical character.

Speaking for lumbermen, yet on his personal responsibility, Mr. von Shrenk declared that the attitude of lumbermen towards fire protection is one of helpfulness and not of hostility.

In Portland the dinner of the Credit Men was attended by numerous state officials, including the state superintendent of public instruction, Prof. L. R. Alderman. The influence of the meeting is indicated by the following dispatch from Salem, the capital of the state, to the *Oregon Daily Journal* at Portland :—

Salem, Or., Feb. 15.—That unnecessary property loss by fire in the United States amounts to $500 a minute and that practically all of this loss could be prevented if people were properly educated on fire prevention, is the assertion made by State Superintendent of Public Instruction, L. R. Alderman, who is preparing a bulletin on fire prevention which he intends to introduce in the public schools of the state as a supplementary reader.

"I may be criticised for adding more material to our school course," said the superintendent, "but as pupils have to be taught how to read, anyway, I believe they might as well be given practical subjects to read."

Material for the bulletin has been furnished by the Portland Association of Credit Men. Superintendent Alderman says the subject is of vast importance, as "all of us have to pay our share of every fire loss in the United States. These losses are assessed to the consumer.

"The distance from Portland, Or., to New York City is 3,181 miles. At $10,000 a mile a splendid roadway could be built between these two places for $31,810,000. And eight of these roads could be built with the $250,000,000 we lose by fire each year. In one year we destroy over half of the value of all the new buildings constructed in the United States.

"And this is not the worst of it. Over 1,400 people lose their lives each year by fire and many more are injured. In the last fifteen years, 20,000 human beings have suffered the agony of death by burning and suffocation, while 90,000 have been seriously injured, and yet the people do not seem to realize the awfulness of it all."

The Portland Credit Men held a special conference, with representatives of all the influential trade bodies, on the day following the evening dinner, at which a committee was appointed to secure the passage of the model fire marshal law and to bring about the adoption of fire prevention day. In almost every city special conferences were arranged for Secretary Wentworth with the city officials. In Denver where the Chamber of Commerce has recently appointed a fire prevention committee, Mr. Wentworth held a special conference with the latter, as indicated by the following extract from the Chamber of Commerce News Bulletin :—

Mr. Franklin H. Wentworth, expert on fire prevention, who was making a tour of the country under the auspices of the Credit Men's Association, conferred with the Fire Prevention Committee of the Chamber of Commerce during his stay in Denver. He went over the local situation in detail with the members of the committee and gave them many valuable suggestions regarding the improvments that should be made in our methods of preventing and fighting fire, which will be worked out by the committee.

One idea which will probably be carried out is Fire Prevention Day. In Indiana and other prominent states a Fire Prevention Day has been established by proclamation of the governor. On this day the attention of the populace is drawn to the importance of preventing fires and methods to be used in stopping the fire waste. Firemen are invited to address the school children by classes, and the whole day is turned over to the subject of fire waste and prevention.

It was through the Colorado Electric Club and the Credit Men's Association that Mr. Wentworth was brought to Denver and we are much indebted to these organizations for the visit, which proved of great value.

In New Orleans where strained relations between the state fire marshal, the Board of Trade and the Underwriters were in evidence, Secretary Wentworth was able to present the significance of the fire waste in its relation to present controversies in Louisiana in such a manner as to aid in modifying common misunderstandings.

It is obvious that, covering so many meetings and traveling such great distances in comparatively so brief a time, little opportunity was given the speakers for any especially constructive work in the cities visited; but owing to the character of the men in the Credit organizations and their live interest in the problem of the fire waste, which is constantly fostered by the National office of the Credit Men in New York, much important work will be undertaken by the local bodies themselves. The following extract from the February Bulletin of the National Association of Credit Men indicates that Secretary Tregoe is to continue, encourage and extend the work so admirably initiated by Mr. Meek.

During the last month, in the company of Franklin H. Wentworth, Secretary of the National Fire Protection Association, your secretary-treasurer visited the cities of Buffalo, Cleveland, Milwaukee, Grand Rapids, Minneapolis, St. Paul and Duluth, where the subject of fire prevention was presented by Mr. Wentworth with his usual force and conviction. At St. Paul, Vice President Chas. E. Meek joined the party and is accompanying Mr. Wentworth upon an itinerary embracing a large number of our local organizations situated in the extreme West, Southwest and South, where we bespeak for them, in every instance, a cordial reception and an attentive hearing.

The economic instinct of the National Association of Credit Men has never been more splendidly manifested than in this earnest co-operation in a vigorous campaign against the perennial fire waste.

What is your local association or what are you individually doing to awaken the public conscience to the national carelessness?

Be interested. Write your secretary-treasurer for suggestions, and let the movement become unanimous throughout the nation for the diminishing of the annual fire loss and of the burden which it imposes upon every individual.

It was almost the unanimous opinion of those in the cities visited that the local recognition of the importance of Secretary Wentworth's message will result, as soon as it has time to germinate, in his being asked to go over

the ground again to address mass meetings of citizens in the largest auditoriums available. Whether or no this may come to pass it is certain that Secretary Wentworth and his associates in the Credit Men's organization have made an impression upon the country of a most direct and effective character, the reverberations of which will be heard for some time to come.

* * * * *

Pres. W. H. Merrill contributed two speeches during the quarter on the general subject of the Fire Waste. On January 23rd he spoke at the dinner of the Insurance Society of New York, held at the Drug and Chemical Club in William Street. He attended the convention of the Electrical Jobbers at Cleveland on February 13th and 14th and brought before the convention the importance of sustaining our Electrical Committee in its endeavor to secure the exclusive use of rubber-covered wire made under the new standard of the National Electrical Code.

* * * * *

The Boston Society of Architects held its second annual "fire protection" evening on February 6th at which two of our members appeared as speakers, former President C. M. Goddard of Boston and Mr. Powell Evans of Philadelphia. Ex-President Goddard took high ground in his address, appealing to the moral responsibility of citizens and deploring the type of commercialism which takes no consideration of human life. We are fortunate in being able to reproduce a portion of Mr. Goddard's address in another column. Mr. Powell Evans addressed himself more to the technical side of fire prevention, advancing numerous resourceful ideas, especially in connection with automatic sprinkler protection. The President of the Boston Society of Architects, Mr. R. Clipston Sturgis, has become an associate member of our Association, and the consideration of the subject of the fire waste on the part of the Boston Society is due to his initiative. Mr. Sturgis was identified with the building of the Boston schools in the days before first class construction was abandoned in those institutions, which change Mr. Goddard notes and deplores in his address.

* * * * *

The chairman of our Committee on Mine Fires, Mr. Herbert M. Wilson, Engineer in Charge of the U. S. Bureau of Mines at Pittsburg, rendered the Association a very valuable service through the delivery of an admirable address upon the fire waste before the Commercial Club of Cincinnati on February 17th. Mr. Wilson prepared Bulletin No. 418 of the U. S. Geological Survey, that admirable monograph on the fire tax and waste of structural materials in the United States. With the statistics of this pamphlet as a basis, the figures of which are well known to most of our members, Mr. Wilson built up a most interesting paper. He made the interesting observation that in Europe, where fire resistive construction prevails and building regulations are designed and enforced with the view to

restrict the progress of fire, there is practically no loss from exposure fires, while the most conservative estimate indicates that at least 27 per cent of American losses results from fire extending beyond the building of origin. He also showed that in a typical year covered by his investigation only $68,000,000 of the loss from fires in the United States was in brick, concrete and other slow burning construction, while double that amount, or $148,000,000 was in frame buildings. "Every dollar spent on fire fighting," said Mr. Wilson, "is a dollar lost so far as the future is concerned; whereas every dollar spent on fire prevention is a dollar saved to the future." Mr. Wilson made the further point that our present ideas as to fireproof construction need revision. "It is not sufficient," he said, "that the outer walls of a building or even its floors and roof should resist fire. It is essential that its interior shall be fire resistive, that its inflammable contents shall be reduced to a minimum and that its exterior shall withstand exposure fires." Mr. Wilson concluded his address by an appeal to the Commercial Club to assume leadership in protecting Cincinnati against the ravages of fire.

* * * * *

Our associate member Mr. Ira G. Hoagland made a very interesting speech at the monthly dinner of the Manufacturers' Association at Bridgeport, Conn., in January. Another of our associate members well known in the field of fire prevention engineering also appeared as a speaker at this dinner. It was Major John Stephen Sewell, formerly of the Corps of Engineers, U. S. A.

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Our associate member Fire Marshal Chas. A. Randall of Nebraska spoke at the Firemen's Convention at Kearney on January 18th, bringing before the fire fighters their responsibilties as fire preventionists as well as extinguishers. Mr. Randall's third annual report just issued gives a list of all fires occurring in the state during 1911, indicating the number in each city. Omaha leads with 620 fires during the year and Lincoln the second with 150. Mr. Randall has recently circulated and urged for adoption model ordinances on the burning of rubbish, waste and other combustible materials, and one providing for the examination and inspection of the condition of houses, buildings, lots, streets and alleys by the Chief of the Fire Department. Beside this excellent work Mr. Randall has addressed special communications to the commercial clubs, bankers and women's clubs asking their co-operation in curtailing the common hazards in which everyone may easily lend a hand.

* * * * *

Mr. Chas. E. Meek is continuing his admirable work in bringing the surveys made by the engineers of the National Board of Fire Underwriters to the attention of the bank presidents in the various cities inspected. Mr. Meek's efforts are now meeting with more encouraging results. The

bankers are beginning to hear the echoes of the national criticism of the fire waste and manifest it by acknowledging more cordially than before the overtures of the Assistant Cashier of the Fourth National Bank. It is probably a safe prediction that Mr. Meek will eventually succeed in securing us the co-operation of the American Bankers' Association as an active member.

* * * * *

One of our associate members in Washington, Mr. F. W. Fitzpatrick, Secretary of the National Builders' and Inspectors' Association, is an indefatigable writer on the subject of the fire waste. His productions are notable for their terse, forceful and convincing English and the artistic manner of their typographical production.

* * * * *

Our active member, the Massachusetts Mutual Fire Insurance Union, addressed in February a most forceful letter to the Chairman of the Board of Selectmen in all the towns of Massachusetts, calling attention to the new Massachusetts Statute respecting brush and grass fires. This Bulletin sets forth the fact that the annual loss by forest fires in the United States has reached the enormous sum of $514,000,000.

* * * * *

Our associate member, the Rochester Chamber of Commerce, through the Chairman of its Fire Prevention Committee, Mr. Wm. J. Trimble, recently issued a Bulletin on the hazards of the domestic uses of gasolene. The Bulletin is very clear and impressive in bringing this hazard clearly before the people in the home and indicates the unremittent activity of our Rochester member in the direction of fire prevention.

* * * * *

Mr. F. W. Offenhauser, Chairman of the Publicity Committee of our active member, the National Association of Local Fire Insurance Agents, has begun an active campaign against the fire waste. His committee has issued two well printed bulletins, one covering the merits of motor driven versus horse drawn fire apparatus, the other containing a speech by Mrs. P. P. Tucker of Dallas, Texas, before the city federation of women's clubs in Dallas, on fire prevention from a matron's view point. To Mrs. Tucker belongs the distinction of initiating fire prevention work in the women's clubs of the country. She has also spoken on the subject before the federation of women's clubs in Forth Worth. Mr. Offenhauser in promulgating Mrs. Tucker's speech says:—

I was so much impressed with the thoughtfulness of Mrs. Tucker in inaugurating this new theme for the consideration of club women and of the wonderful possibilities which its adoption by Women's Clubs the country over, presented, that having secured Mrs. Tucker's consent to reproduce this excellent paper, I have caused it to be printed and take pleasure in placing in your hands a supply, together with the card, "Will you be a Fire Warden and Saver of Life?" embrac-

ing "pledges for the safety of the home," which you will observe are intended to be hung in conspicuous places in the kitchen, laundry and fireroom of the dwelling.

We all know that where woman becomes interested and enthused in any line of education or civic improvement, her work is always so well done that we have come to expect nothing but success of her every effort.

The acknowledged influence of the fireside in moulding the character, morals and sentiment of the family opens for us a channel of rare opportunity for the development of attributes conducive to fire prevention.

It is obvious that a great work can be done in interesting the women of the country in fire wardenship through the admirable agency presented by the national and city federations of Women's Clubs. There is no reason why the National Fire Protection Association should not have women members as well as men. Co-operation of both is essential.

* * * * *

Our associate member, Captain C. Albert Gasser, Inspector of the Bureau of Combustibles and Fire Risks in Newark, N. J., has been exceedingly active during the past year in his efforts to reduce the local fire waste, assuming in such work many duties and responsibilities frequently evaded by municipal officials. He has recently issued bulletins requiring the keeping of all matches in mercantile establishments in metal boxes or other fireproof receptacles, also a bulletin recommending that all awnings should be properly fireproofed before erection for the summer season, following the methods of the theatres in fireproofing scenery. Captain Gasser points out that numerous fires last year were caused by cigars or cigarettes falling upon awnings. The city itself is taking the lead in this work, fireproofing the awnings at city hall and at fire department headquarters. Captain Gasser urges the citizens to avail themselves of the advice and services of his Bureau. Inasmuch as there were fewer fires in Newark in 1911 than in any year for the past 10, it is obvious that the active and painstaking work of Captain Gasser is bearing the desired fruit.

* * * * *

Another of our Newark members, indefatigable in his work for fire prevention, is Mr. John M. Hughes, who spoke in February before the New England Society of Orange, N. J., in favor of bills before the present session of the legislature, aiming at the establishment of a fire marshal law. Mr. Hughes' emphasis upon the importance of such a law drew from the Society a resolution referring this question to the Public Welfare Committee for consideration.

* * * * *

Our associate member, Mr. Chas. E. Eldridge of Topeka, has recently issued an admirable letter to the Mayors of cities in Kansas, bringing before these officials the necessity for the adoption of electrical ordinances. He has been successful in securing the adoption of an admirable ordinance in the city of Topeka which goes so far as to require metal conduits in all

new work. Mr. Eldridge enclosed with his letter to the Mayors an article on municipal supervision of electrical wiring and apparatus, what it is and what it does. Few good things in fire prevention are brought about in municipalities without such persistent and intelligent work as this.

* * * * *

Our active member the Minnesota State Fire Prevention Association recently made a descent upon the city of Bemidji, Minnesota, and so impressed the citizens with the importance of their quest that the local paper, *The Daily Pioneer*, appeared on the date of their visit printed entirely upon red paper! This procedure should have been sufficient to convince almost anybody.

* * * * *

The cultivation of the idea of fire prevention among the public school children is one of the most effective means of checking the fire waste. A habit formed in youth is likely to dominate a lifetime. Insurance Commissioner Willard Done, of Utah, one of our associate members has thought of a plan which promises excellent results. With the approval and cooperation of the Superintendent of the state schools he has offered money prizes for the first and second best essays on fire prevention written by the pupils of certain grades who are not over sixteen years old. The aim is to have the winning essays worthy of the distinction of being read and published as a part of the exercises of Fire Prevention Day, October 12, 1912. Undoubtedly the competition aroused among the pupils will work for good not only with them but with their parents and friends likewise. Commissioner Done is continually active in promoting measures for the improvement of conditions in Utah. In this instance he has begun a movement in the interest of fire prevention out of his own pocket. It would be well for the public authorities everywhere to consider whether the commissioner's example is not worth following.

* * * * *

Our associate member Mr. Rudolph P. Miller, Supt. of Buildings of the Borough of Manhattan, in a brief submitted to the New York State Factory Investigating Commission, goes thoroughly into the subject of exit facilities for buildings,—more particularly factories in the metropolis. The importance of the question of adequate means of egress is most interestingly and comprehensively set forth. The brief has been published in pamphlet form and although we are not authorized to say so, we believe Mr. Miller might be willing to furnish copies of the same to any member of the Association especially interested.

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Secretary Wentworth spoke on April 10th at the monthly dinner of the New England Foundrymen's Association at the Exchange Club at Boston and on April 25th at the first annual banquet of the Fire Insurance Society of Pittsburg, Pa.

The Architect and the Fire Waste.

By C. M. Goddard (Member N. F. P. A.)

(Extract from address before the Boston Society of Architects, February 6th, 1912.)

Architects, in many individual cases, and through their associations have done much to assist in bettering conditions. The late Mr. Alfred Stone of Providence gave a great deal of time, for years, to work in connection with the National Electrical Code. Mr. Robert D. Kohn, as the representative of the American Institute of Architects on the Executive Committee of the N. F. P. A., and your own Mr. C. H. Blackall and others have been of invaluable assistance to us in our work for better standards of construction; but this is not enough, and we look earnestly for the time when the men who, if they will, can control the general practices and customs of the building trade, will present a united front, pressing forward to the adoption of such standards as will entitle this nation to the reputation of caring more for future results than for the profits of to-day; when we can refute the claim that we are interested only in our individual, selfish, momentary profit and pleasure, and can justly claim that we take some care for the profit, pleasure and protection of the brotherhood of man.

The recklessness of the American people in taking a chance, and the love for the almighty dollar are characteristics which must be modified before we can accomplish the desired ends.

It was dollars that made the old building in Newark, N. J., a better investment to rent or buy; it was dollars that crowded the Asch building and locked the doors; it costs dollars to give employees time for fire drills, and it costs dollars to erect properly protected stairways, and efficient fire escapes; in fact it is all a question of dollars.

The American people mean well, but they have acquired the habit of thinking in dollars instead of lives, of thinking in dollars for to-day instead of in thousands of dollars for the future. We are not a people who are taught by startling examples. The effect of these is transient. Our teaching must be by education which makes for permanent character.

Only a few years after the Collingwood school disaster Boston decided to change the school building requirements from strictly fireproof to substandard fireproof. It costs too much to give absolute protection to her school children!

Less than two weeks after the Bangor conflagration the Massachusetts General Court killed a bill prepared by experts and recommended by the Mayor to lessen the conflagration hazard in Boston by requiring fire-resisting roofs, fireproof party walls, and open spaces between frame buildings in the

tenement and apartment house district. The Mayor says, "What methods the lumber interests, which were so active in opposing the bill, may have used I cannot say, but I know that in the fair field of open argument they were completely overthrown and left without a single plausible excuse for their opposition." Here again the action of the lumber interests was due to the question of dollars being placed above lives.

Less than a year ago I was obliged to send an expert to appear before the Aldermen of a city which adjoins Chelsea, to argue against the repeal of an ordinance which prohibits shingled roofs. One might have thought that the Chelsea conflagration, which was largely due to shingled roofs, would have outweighed the influence of the builders who build simply to sell, for it was from that class that the proposition for repeal apparently originated. A slate roof costs but little more, and in the long run is cheaper than shingles, but in a cheap house built to sell the builder cares nothing for the long run and everything for the first cost.

If we are to prevent conflagrations, we must have better fire-resistive construction. We must build so that our fire departments may confine the fire to the building in which it starts. Inflammable roofs and other similar superstructures breed conflagrations from flying sparks and embers. Unprotected window openings allow the lateral spread of fires from building to building. Frame sheds and out-buildings in the rear of otherwise fairly good fire-resistive buildings carry the fire in the rear from one building into another. Good internal protection such as is afforded by automatic sprinklers is a powerful adjunct in confining fires to the building in which they originate. Reasonably small floor areas and protected vertical openings in floors, especially where buildings are filled with combustible goods, are a great advantage. Fire extinguishers, inside standpipes and hose, and fire pails which are readily accessible, will frequently control a fire which otherwise might prove serious and even result in a conflagration.

No body of men are in better position than the architects to assist in the education of the public along the lines of better building construction, which will do much to relieve us of the disgrace of every year burning half the value of the new buildings we erect.

Experts of the United States Government, after thorough investigation, estimate the cost of our annual ash heap, excluding forest fires, at nearly half a billion of dollars, and Massachusetts alone in the first six months of 1911 destroyed over half a million dollars in forest fires. May I not justly claim that the conservation of our created resources from destruction by fire is a subject worthy of your attention?

I think I fully appreciate the position which the architects occupy,—that it is your business to produce what your customers want, as they want it. At the same time, you must admit that your customers come to you because they believe you know more about what a building should be than they do, and that you can, to a great extent, influence them to build along safe and sane lines. Your knowledge of the strength of materials tells you just what is necessary for the safety of a structure from the standpoint of

stability, and I venture to assert that you would refuse to stand sponsor, as architect, for a building if you felt it must be so built that it was a menace to its owner and occupants. Is it not equally your duty to familiarize yourselves with the requirements which will prevent a building from becoming a menace, through fire, not only to its owners and occupants, but to its neighbors and perhaps to a whole city? You go abroad to study architecture in cities more beautiful than ours. Is it necessary on your return that you use wood to build and shingles to cover the buildings you design from what you have gathered there, when such materials are practically unknown in the places you have visited?

Gentlemen, there is just one way in which we may effectually and permanently put a stop to the appalling loss of life and property by fire, and that is by educating public opinion so that we will look upon the unnecessary loss of life and property through some one's carelessness or neglect as we do on manslaughter and stealing, as a crime rather than as a misfortune. Our laws and building codes will then be enforced because we all wish it, rather than be evaded as now, if it can be done by deceiving or corrupting the building inspector. Law alone, without this public opinion, will not accomplish the result.

Cities will still discover that almost every known law as to theatres is evaded as soon as such spasms of public horror as the Iroquois disaster have subsided.

Courts will acquit men, like the proprietors of the Triangle Shirtwaist Company, in the face of conclusive evidence that violations of the law caused the death of 146 human beings, because, forsooth, it could not be proved that the violation was the actual cause of the death of the poor girl specifically mentioned by name in the indictment!

People will still plead for the shingled roof from æsthetic and commercial reasons, in spite of the fact that it is admitted by all experts and every fire chief to be one of the most flagrant causes known for spreading fires and producing conflagrations.

Notwithstanding the fact that hundreds of lives and millions of dollars are annually lost through fires from "strike-anywhere" matches, men will offer to Massachusetts Legislators as a reason why the sale of other than safety matches should not be prohibited, that the carrying of a box of matches in the pocket would disfigure the symmetry of the outlines of a man's dress-suit, and still not be hooted from the committee room; and items such as recently appeared in the *Cleveland Plain Dealer*, announcing that five babies were burned to death in that city from match fires inside of three days, will still adorn our daily papers.

It has not been my intention to speak to you this evening simply as the representative of the fire insurance interests. No man can call his life a success who uses his chosen vocation simply as a means of getting the dollars which buy his daily bread and never draws lessons from his work which may assist him in being of benefit to someone besides himself. What I have said has been with the idea of emphasizing the necessity of arousing

public opinion, a lesson that comes to me whether I wish it or not in my daily contact with the effects of fire: Most useful when our servant, most cruel when our master.

May we not, every one of us, go back to our daily tasks with the determination that none of the responsibility for the fire curse of this country shall rest on us, and that in so far as in us lies we will do our part toward hastening the time when our cities and towns shall be so built, so protected and so cared for that we may point with pride instead of shame to our fire record when compared with that of other nations.

The Equitable Building Fire.

Summary.

Construction. The Equitable Building which burned on the morning of January 9, 1912, was a composite structure of five buildings erected at different times. It was of so-called fireproof construction, having floors mainly of wood on brick or hollow tile arches between wrought-iron and steel I-beams. The beams rested on walls and on columns mostly of cast-iron. The building was vitally weak in the fact that the structural metal work was not fireproofed and the cast-iron columns failed, causing three separate portions to collapse.

The first building of the Equitable Life Assurance Society was a five-story structure erected in 1869, with a frontage of 87 feet on Broadway and 135 feet on Cedar Street. The frontage on Cedar Street was later increased to 234 feet. In 1886 the south wall was taken down and the building extended along Broadway to Pine Street, facing 195 feet on the latter street. The height of the original building was increased to eight stories to correspond with the extension. An extension 50 feet wide was also built through to Nassau Street (Nos. 19-21). In all this work the same general scheme of architecture was carried out except such improvements were made in construction as the progress of the building art would seem to warrant, notably the use of tile floor arches in place of brick. The height of the reconstructed building was equivalent to ten stories. The small lower buildings completing the block and located at the northeast and southeast corners were subsequently acquired by the Equitable Society and openings were made through the dividing walls, converting the whole block into one fire area. The entire block is approximately 48,000 square feet in area.

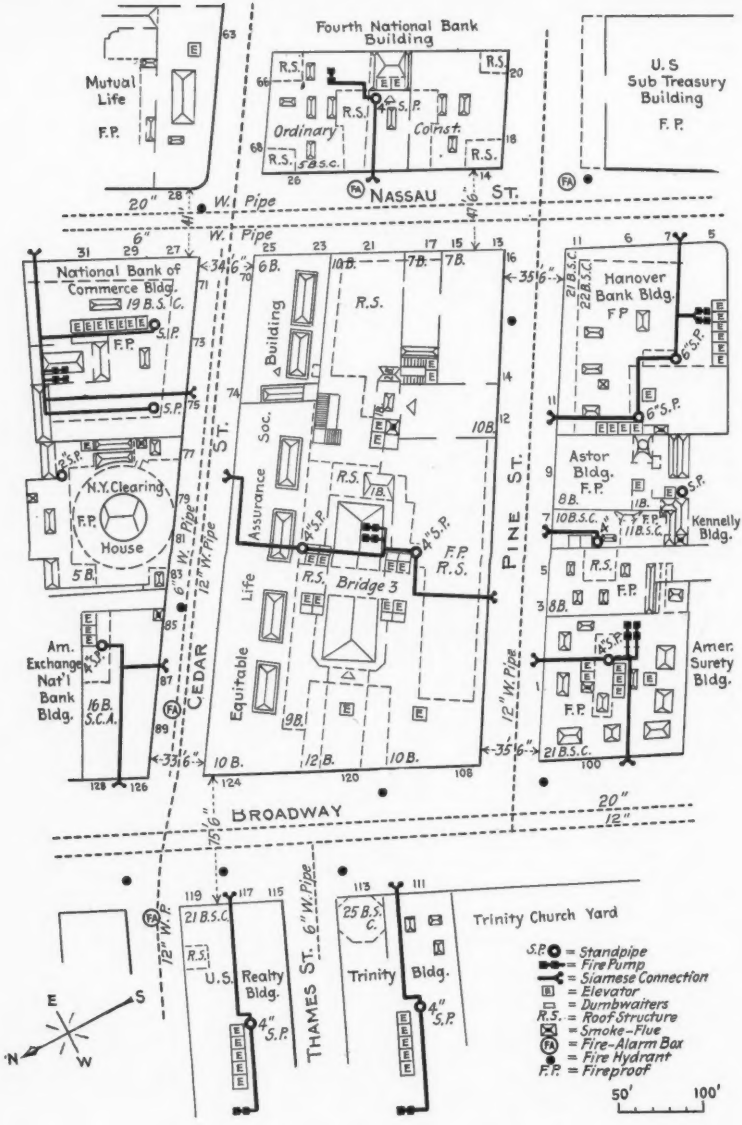
Damage. The greater part of the main building was gutted by the fire, which burned through all floors above the grade. A few areas such as the Cafe Savarin dining rooms on the grade and first floors, and the offices in the east end of the building up to the fourth floor, escaped the fire but were considerably damaged by water. With the above exceptions

THE EQUITABLE BUILDING BEFORE THE FIRE
Broadway and Cedar Street Corner

the destruction was practically complete as regards everything—combustible or incombustible—in the nature of contents, trim and finish.

The structural work on the Cedar Street side above the third and fourth floors and on the Pine Street side above the sixth floor is badly damaged by the fire; at these points the beams and girders are generally deflected and likewise the columns are buckled or broken. The Cedar

PLATE 1



General Plan of the Building, Exposures and Standpipes

Street side shows the worst damage in this respect. The structural work in the east extension (Nos. 19-21 Nassau Street) suffered little; there were a few deflected beams.

In three separate portions of the building the floors collapsed (see Plate No. 2 for location and extent), apparently due to the failure of unprotected cast-iron columns. The largest collapse, near Broadway, carried all floors and the roof down to the basement. In the middle section, near Cedar Street, the floors from the second to the eighth fell, leaving the roof standing. At part of the east collapse near the main stairway the roof and all floors above the third fell; in the remaining portion the collapse extended down to the second floor.

The seven-story building, 14-16 Pine and 13-15 Nassau Streets, was burned over on the upper two floors. Otherwise the building suffered only by water. Its escape was due partly to the fact that there were no communications with the main building on the lower two floors and the communications to the other unburned floors were indirect. The structural work of this building was uninjured.

The six-story building, 23-25 Nassau and 70-74 Cedar Streets, communicated with the main building on all floors, yet the fire did not enter the former and practically the only damage done was by water. The work of the fire department was most effective at this end.

Features of Interest. In the destruction of six lives and large property value by this fire the unprotected floor opening has added another to its list of horrors.

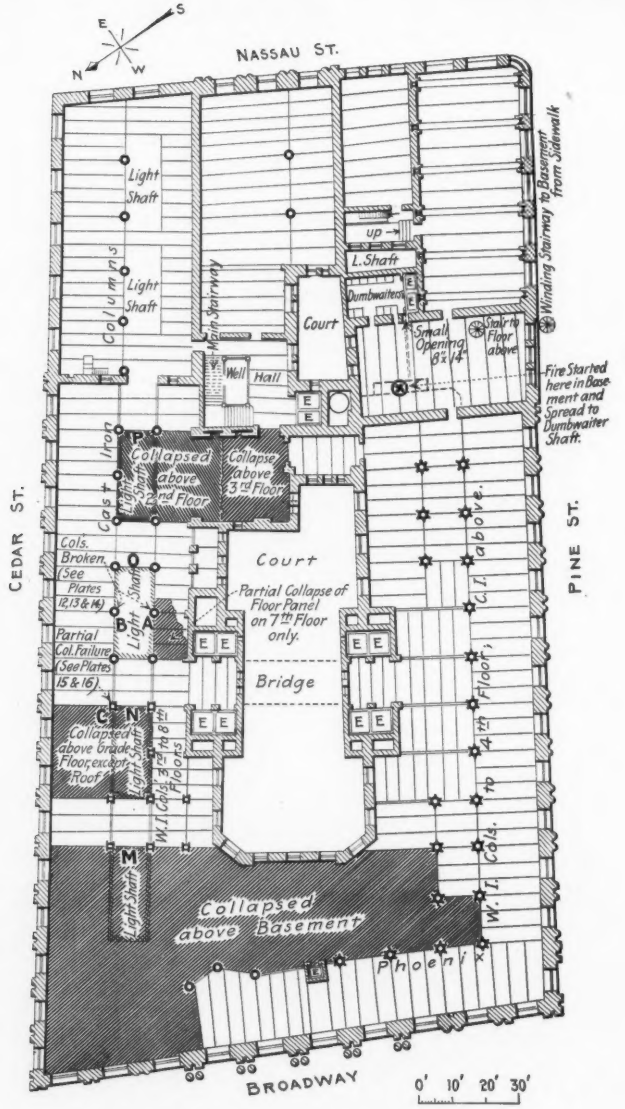
Aside from the striking evidence that a so-called fireproof building occupied chiefly for offices may foster a quickly spreading fire, most of the lessons pointed out in this case have been demonstrated by former calamities.

The supposedly favorable condition incident to the existence of high fireproof buildings across unusually narrow streets and each equipped with one or more standpipes, also furnished a new and interesting experience in fire fighting which was not altogether satisfactory, having particular reference to the inadequacy in size of some of the standpipes.

The abnormally large amount of securities and valuables in vaults and safes exposed to the fire and impact as well as the weight of the building collapse was an unusual condition which attracted wide interest. None of the more important vaults were severely tested by heat. The safe deposit vaults were buried under the full weight of the principal floor collapse and resisted it well. None of the vaults were waterproof.

Although the fire department is entitled to the credit of having done all that could be expected with the facilities available, it is apparent that the fire, at least above the level of the fifth floor, burned unrestrained throughout the entire area of the main building. The high pressure service being too remote to be promptly available, it is difficult to figure how such a fire, if started again under similar circumstances, could be fought with any greater effectiveness by the fire department when the

PLATE 2



Plan showing Beam, Girder and Column Arrangement—Principal Floor Openings and Collapsed Sections

conditions of unprotected floor openings, combustible material, excessive and undivided floor areas, high wind, freezing weather, small standpipes in buildings across streets and the relative inefficiency of portable steam engines in comparison with the high pressure service are taken into consideration. If such a fire were started during business hours the work of the fire department would be impeded by the congested condition of the narrow streets and the endeavors of the firemen to rescue the numerous occupants whose only means of escape—a single stairway—might be cut off, as it was in the case of the three employees on the upper floors who lost their lives. The collapse of cast-iron columns was responsible for the loss of three additional lives.

This fire, like those in the Parker Building, Triangle Shirt Waist Factory and Alwyn Court Apartment House, calls attention to the inability of any fire department to effectively fight a fire which has once gained headway in the upper stories of a tall building lacking such essential fire appliances as an adequate standpipe equipment in conjunction with smoke-proof stair towers. The height of buildings should be limited in proportion to the effectiveness of their fire protection if life and property are to be conserved.

Origin and Spread of Fire.

The timekeeper of the Cafe Savarin arrived at the building about 5 a. m., the day of the fire, and went immediately to his office, a small frame enclosure, 4 x 12 feet, in the receiving room, located in the basement of No. 12 Pine Street. He lighted the gas in his office and threw away the match. At about 5.18 a. m. another employee discovered the fire in the timekeeper's office. The waste-paper basket, chair and desk were burning briskly.

The fire did only moderate damage in the receiving room but spread to a tile enclosed shaft containing two elevators and eleven small dumb-waiters enclosed in wood. The dumb-waiters and elevators served the dining rooms of the Lawyers' Club and the Cafe Savarin, from one kitchen on the eighth floor. The shaft had openings directly to each story except the fourth. It is claimed that some of the openings had rolling iron shutters. They were evidently open or defective. The other openings had wood doors. The flames quickly extended throughout this shaft and entered the upper stories almost simultaneously. The fire in the shaft did not communicate with the lower floors; the shaft acted as a chimney, the draft being inward at the lower levels and outward at the top. The fire traveled fastest through the large area of the club rooms and kitchen, which were almost without sub-divisions by even ordinary partitions and contained much combustible trim and furnishings. Probably within forty-five minutes after its origin the fire had spread over most of the main building above the fourth floor and was rapidly working its way down to the lower stories through numerous light wells and other

unprotected floor openings. In approximately twenty minutes more the first (east) collapse of the floors occurred, followed thirty-five minutes later by the second or general collapse extending along the Broadway and Cedar Street fronts. In about four hours the fire had destroyed practically everything combustible in the west half of the building above the grade floor and similarly everything in the east half above the fourth floor. It was held in check in the lower stories at the east end and was under con-

The Equitable Building, Broadway and Cedar Street Corner—Two Days after the Fire—Water still being thrown on wreckage of Main Collapse over the Safe Deposit Vaults

trol in the remainder of the building about 9.30 a. m. By noon it was mostly out, although burning quietly in some inaccesible portions of the building until late in the night.

Conditions at Time of Fire.

Favorable Conditions. The fire occurred at an hour of the day when the streets were practically deserted and afforded the fire department every opportunity of getting to the fire promptly without serious obstructions such as would inevitably occur during business hours in this exceedingly congested portion of the city. Moreover, if the building had been full of occupants at the time of the fire, there would probably have been an excessive loss of life which would have diverted the attention of the fire department from fighting the fire.

The high fireproof buildings nearby, equipped with inside standpipes, supplied from steamer connections at the sidewalk and private fire pumps from within, afforded ideal conditions for operating streams at any desired level, especially across Pine and Cedar Streets, which are exceptionally narrow, being only 35½ and 34 feet wide respectively.

The Equitable Building was of moderate height in comparison with many so-called fireproof buildings in New York.

The building was occupied largely for offices which are not ordinarily regarded as conducive to quickly spreading fires.

Unfavorable Conditions. The weather conditions were very unfavorable. When the fire started the wind was blowing from the northwest at an average rate of 37 miles an hour. The velocity increased and during most of the fire averaged approximately 55 miles an hour, rising to occasional maximums of 65 to 68 miles. The temperature was 35° above zero Fahr. at the start of the fire and fell rapidly, being less than 20° before the fire was under control.

Although the wind was from the northwest the tall buildings across Broadway deflected it through Trinity Churchyard, so that it struck the building on the Broadway front from a westerly direction.

As there were but few persons in the building at the time of the fire it gained access to the upper floors without being promptly discovered. The fire was thus enabled to spread to an extent where it was beyond control before any concerted effort could be made to restrain it.

The number of unprotected floor openings and large areas, unbroken except by non-fireproof partitions—notably in the restaurants—favored the rapid spread of the fire.

How the Fire Was Fought.

Private Appliances. The building was equipped with two 4-inch standpipes located one on each side of the building near the main elevators, supplied by two tanks of 2,250 gallons capacity each, also by siamese fire department connection on street. Each standpipe had a 2½-inch outlet with 100 feet of 2½-inch unlined hose on each floor. The

standpipe tank was filled by a 3-inch pipe from two duplex steam pumps. The capacity of one was 350 and the other 450 gallons per minute. Each took suction by a 4-inch pipe from city mains. These pumps had also a 3-inch connection direct to the standpipe system.

After the fire was discovered, about 5.18 a. m., employees stretched hose from the inside standpipe equipment, but on attempting to use it found the hose was too short. Considerable time was lost in providing an adequate length of hose. A policeman, when notified by one of the employees of the Cafe Savarin, investigated the fire and at once called to another policeman who turned in an alarm from street box No. 24, corner Nassau and Pine Streets at 5.34 a. m. It is estimated that approximately sixteen minutes elapsed between the discovery of the fire and the receipt of the first alarm.

Fire Department—Inside Operations. The first engine company to arrive took a hose line to the basement by the winding stairway leading from the sidewalk. The fire in the time-keeper's office and receiving room was promptly controlled, but it was later discovered that the flames had communicated with the dumb-waiter shaft. It was not then apparent to what extent the fire had spread beyond the shaft and the firemen went up through the building to investigate. As the shaft was somewhat inaccessibly located with respect to the only stairway, it took an appreciable time to determine the full extent of the fire and the necessity for a second alarm.

Eight companies entered the building and operated approximately twelve streams on the second, third, fourth and fifth floors for periods ranging from fifteen minutes to one hour. Some of these streams were taken off the inside standpipe which was supplied by the private pumps in the basement and a steamer connected to the outside siamese coupling.

All members of the fire department were ordered out of the burning building about 6.35 a. m., shortly before the first collapse occurred, Battalion Chief Walsh being the only member who did not escape. Later during the fire a number of streams were operated on the lower floors at the east end, mostly by means of ladders to windows.

Fire Department—Outside Operations. Scarcely any attempt was made in the early stages of the fire to fight it with hose streams directed from the level of the street. Such an attempt would have been futile, owing to the narrow streets and high wind. The streams were mostly directed from the upper stories of the high buildings opposite across narrow streets, by hose lines taken from the standpipe outlets on various floors. The standpipes were usually supplied by a local fire pump and one or more steamer hose lines secured to the siamese connection at the street. There were a number of streams operated from the roofs of 14-20 Nassau Street and 77 Cedar Street. Two water towers were used. A few streams were directed from the street level in Broadway, but these were evidently used chiefly to wet down the ruins in the vicinity of the vaults.

The effect of the high wind was to blow the hose streams into a fine

PLATE 7

Hose Streams on Broadway—Note how the Streams were turned into Spray by the Wind. Throw of Upper Stream about 70 feet

spray, and at some points streams were not effective at seventy feet—notably on Broadway—see Plate No. 7. On the sides bounded by Pine, Cedar and Nassau Streets, the effectiveness of the hose streams from the standpipes was also greatly diminished by the wind. It affected the high pressure streams from the separate fire main system less than those from the steamers.

There was ample water in the street mains at all times to supply the steamers, although the pressure fell as low as five pounds for a while. The mains were of sufficient size.

High Pressure Service. The nearest hydrant of the high pressure service was approximately eight hundred feet from the part of the block where the fire originated. This placed the service beyond the limit of distance within which it is ordinarily considered as available. It was, however, used later when the operations of the fire department were extended to Nassau and Cedar Streets, the nearest hydrant being about five hundred feet from the intersection of these streets.

The high pressure service supplied eight hose lines, seven of which were 3-inch hose and one was 3½-inch. They were attached to two hydrants at the corner of Nassau Street and Maiden Lane. Two of these lines supplied the mast nozzle of Water Tower No. 2 in front of No. 21 Nassau Street; two furnished an equal number of streams on roof of No. 77 Cedar Street; two were attached to a siamese standpipe connection on building No. 31 Nassau Street; one was connected to Water Tower No. 1, but not used; one line was carried to second floor of No. 128 Broadway.

Burst Hose. A total of 15 lengths of fire department hose burst during the fire. Fourteen lengths were 3-inch hose and one length was 2½-inch. This is not considered significant in view of the amount of hose in use and its frozen condition.

Temperatures Developed in the Fire.

The temperatures developed in this fire appear to be slightly lower than have been observed in some other so-called fireproof building fires. Glass and brass fixtures in the upper parts of the rooms, such as electric fixtures and the blades of electric fans, fused freely (estimated about 1,600° Fahr.). In the dining rooms and kitchens silverware was fused, as were also brass door knobs and speaking tubes. A brass standpipe valve on one of the upper floors showed incipient fusion. No cast-iron or steel parts were found to be fused (steel melts at about 2,450° Fahr.; cast-iron at 2,200°). The fire was probably hottest around the four light shafts on the Cedar Street side of the main building and in the basement at the point where the insulation burned off the telephone and telegraph wires.

Exposure to Surrounding Property.

The buildings exposed to the fire range in height from five to twenty-one stories and are of fireproof construction, except the Fourth National Bank Building, Nos. 16-24 Nassau Street, which is of ordinary construc-

PLATE 8

Operations of the Fire Department on Nassau Street. The Principal Stream is from the Mast of Water Tower No. 2, supplied by two three-inch Streams from the High Pressure Service. The Direction of the Stream is too near the Vertical to be Effective inside of the Building

ton, five stories high. The streets are unusually narrow on three sides, Pine Street being 35½ feet, Nassau Street 47½ feet, and Cedar Street 34 feet wide. Broadway at this point is 75½ feet wide.

It is stated that the flames at times reached more than half the distance across Cedar and Nassau Streets. It is somewhat remarkable that no damage was done by the fire to the buildings across these streets. As far as can be ascertained, only a few window panes were cracked by the heat. Several window frames were somewhat burned in Nos. 70-74 Cedar Street, but these were ignited by fire brands carried by the wind. Considerable credit is due the fire department for this lack of damage, as they made a special point of preventing the fire from spreading to adjacent buildings. It has also been suggested, in accounting for the lack of damage to the buildings across narrow streets, that the abnormally high wind and comparatively low temperature of the air dissipated the heat so rapidly that an opportunity was not afforded for the sudden increase in temperature ordinarily to be expected from flames impinging nearly across the streets.

Property Loss.

Building. No detailed calculation has been made to ascertain the exact amount of damage to the building estimated on a basis of valuation. A general consideration of the building after the fire would indicate that it was damaged to the extent of about seventy per cent of its value. The cost to replace the building is roughly estimated at about $3,500,000, independent of any depreciation. No fire insurance was carried on the building.

The contents were owned by a large number of individuals and firms. Apparently very little fire insurance was carried thereon, and therefore an opportunity has not been afforded for a careful estimate of the damage. Roughly figured, it will probably amout to eighty per cent of the total value, exclusive of the contents of vaults and safes.

Occupancy.

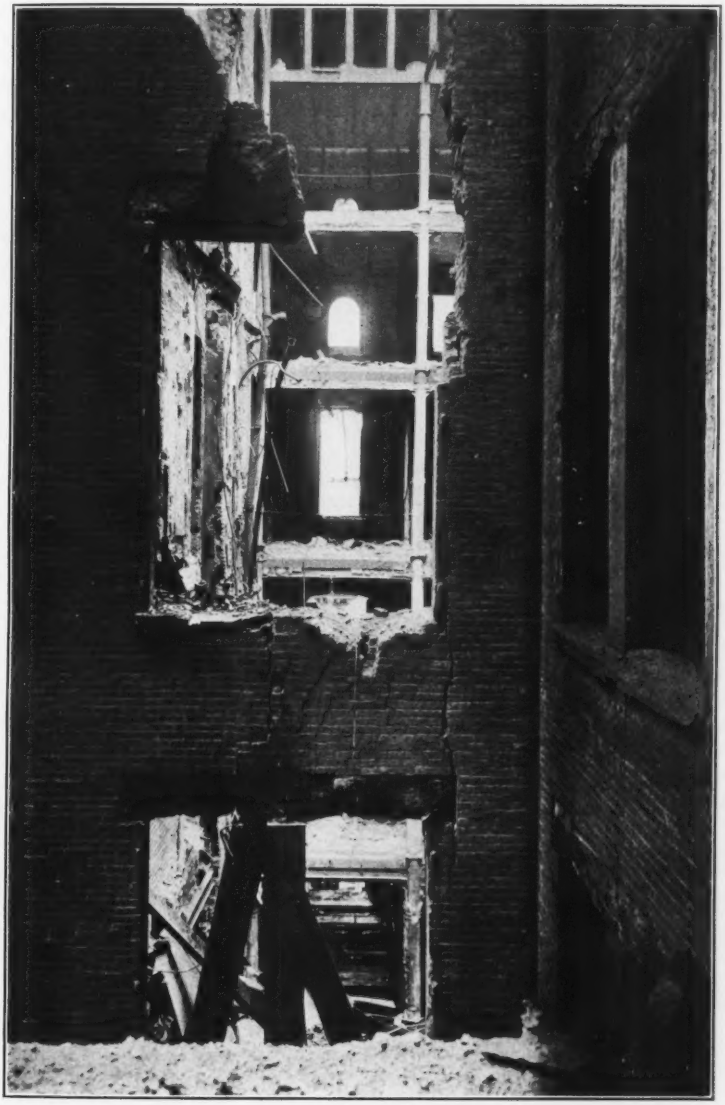
The occupancy consisted principally of offices. The Cafe Savarin occupied large areas in the basement, ground floor, eighth and ninth floors. The Lawyers' Club had a large part of the fifth and sixth floors. The Equitable Life Assurance Society occupied all of the second floor and gallery. It was through these floors, containing large undivided areas, that the fire spread rapidly.

A summary of the occupancy of each floor follows:—

Basement. Boiler room, nine boilers located on the Nassau Street side of building, steam engines and pumps. Mercantile Safe Deposit Co.'s vaults. Cafe Savarin, wine cellar, and storage of supplies.

Grade Floor. Arcade; telegraph and telephone booths and office; barber shop; Toney's bootblack parlor; Arata, fruit stand; Powell, Repetti, Inc., candies; Gould's, stationery; Art Pyrographic Co., burnt wood and leather novelties; Weck, cutlery; Lyons, umbrellas; Bazaar

PLATE 17



Wall Failure, East End of Main Court, due to Broken Cast Iron Window Lintels and Spalling of Stone Facing, allowing Cast Iron Mullions to drop out

du Voyage, trunks and bags; Mercantile Library (branch); Poland Mineral Water Co., stock; Mercantile Safe Deposit Co., vaults and office; Cafe Savarin, dining room; Equitable Trust Co., offices and safe deposit vaults; W. A. Read & Co., offices.

1st. Kountze Bros., offices; Mercantile Trust Co., banking offices; Equitable Life Assurance Society, offices; Cafe Savarin, ladies' dining room; Equitable Trust Co., offices and banking room; Belmont & Co., offices.

2d. Equitable Life Assurance Society, offices.

Gallery. Equitable Life Assurance Society.

3d. Union Pacific Railroad Co., offices; Equitable Life Assurance Society, offices.

4th. Union Pacific Railroad Co., offices; balance contains a number of small offices, mostly lawyers.

5th. Union Pacific Railroad Co., offices; Lawyers' Club, smoking room, reading rooms and dining rooms; also a number of small offices, mostly lawyers.

6th. Alexander & Green, offices; Lawyers' Club, dining rooms; balance small offices.

7th. Small offices, mostly lawyers.

8th. Law library; kitchen for Cafe Savarin and Lawyers' Club restaurant; three sets coal heated French ranges, a number of steam heated boiling kettles, small gas heated testing oven, three large bake ovens, brick set, coal heated; balance, offices.

9th (roof structure). Disused laundry; offices and supply rooms of Cafe Savarin.

Building—Details of Construction and Damage.

Walls. The fronts of the building facing on Cedar, Broadway, Pine and Nassau Streets, consisted of massive brick and stone walls, the brick being forty to sixteen inches thick, faced with granite ashlar eight to twenty inches thick. The walls were part bearing and part self-supporting but non-bearing. On the Broadway side ornamental granite columns supported heavy ledges at the levels of the second, third, fifth and sixth floors; partly projecting columns performed a similar function on Cedar, Pine and Nassau Streets.

The brick backing to the walls on Pine Street and two-thirds of the Broadway side was solid. On the Cedar Street side of the building and the remainder of the Broadway wall, the brick backing was hollow, containing large pipe shafts, making a weaker wall at these points. (See Plate No. 18.) When the height of the original building was increased the Cedar Street wall was so weak that hollow metal ornamentation had to be used at the top to imitate the masonry used elsewhere.

The brick work over the windows was supported by heavy cast-iron tee lintels faced by self-supporting granite work. The window sills were also of granite.

PLATE 18

Cedar Street Wall, corner of Broadway, Inside View showing Pipe Channels

The walls between the main building and those at the northeast and southeast corners were built of brick and ranged from fifty-four inches at base to twenty inches thick at top.

The brick bearing walls at the interior courts ranged in thickness from forty inches at the base to sixteen inches at the top. Here also were cast-iron tee lintels faced in this case by limestone; the sills were also limestone. The wider windows had a heavy hollow cast-iron tee mullion resting on the stone sill and supporting the cast-iron tee lintel as well as the stone facing; it was not, however, fastened to them in any way.

Damage. All exterior walls were standing after the fire. On the Cedar Street side near Broadway the top of the wall has apparently fallen. This section, however, was built of metal to imitate stone and cannot properly be considered part of the wall. At this point the wall is out of plumb, due to the weakness of the hollow backing and the falling of the floors. The bricks on the inside of this wall are somewhat spalled and the floor beams in falling tore out large sections of the brick work. (See Plate No. 18.) Elsewhere the exterior walls appear to be in good condition.

The spalling of the stone facing on street fronts was not excessive, considering the magnitude of the fire. On the Cedar Street side near Broadway, the stone work is badly chipped over and about the windows on the fifth and two windows on the second and gallery floors. The lintels of two windows on Broadway north of the main entrance are chipped. The main damage to stone work was shown on Pine Street where the lintels and ornamental stone work are damaged on all floors above the second near Broadway, on the fifth the entire length of the building, and on the fourth near the Nassau Street corner. The sixth story on Nassau Street shows similar damage.

The walls of the main court are standing except that the west wall above the sixth story has fallen; below this point cracks appear and bricks are badly spalled. At the east end a section between windows has fallen out at the upper four stories, and the wall is badly split below, due to the failure of the cast-iron tee lintels, also by the spalling of the limestone sills, allowing the iron mullion to drop out. (See Plate No. 17.) In the smaller court to the east the stone sills and lintels were almost totally destroyed. The walls are cracked and the brick work badly spalled. The court seems to have acted as a chimney.

Floors. The floors of the building (with the exception of the halls, corridors and offices of the Equitable and Mercantile Trust Companies, which were of marble, also part of the Lawyers' Club, which was mosaic), were double of wood, the finish floors being of oak or pine, on $2\frac{1}{2}$ x $2\frac{1}{2}$-inch wood sleepers. On the upper floors the sleepers were filled between with hollow tile (tiles $2\frac{1}{2}$ x 6 x 8 inches) with half-inch shell and web—see Plate No. 3—laid loosely on a 3 to 6-inch cinder concrete fill; in the lower floors cinder concrete was used to fill between the sleepers. At a few locations on the Cedar Street side and elsewhere throughout the

PLATE 3

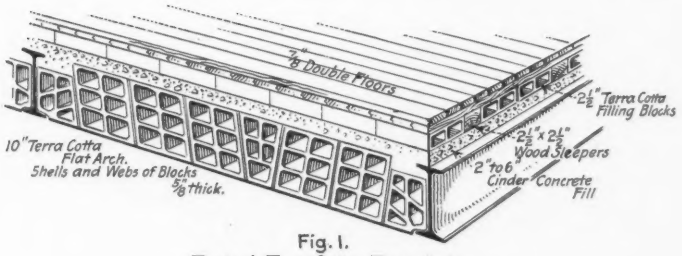

7/8" Double Floors
2½" Terra Cotta Filling Blocks
2½" x 2½" Wood Sleepers
2" to 6" Cinder Concrete Fill
10" Terra Cotta Flat Arch. Shells and Webs of Blocks 7/8" thick.

Fig. 1.
Typical Terra Cotta Floor Arch.
(In the Lower Floors the Terra Cotta Fill was Omitted and the Cinder Concrete Carried up to the Floor Boards.)

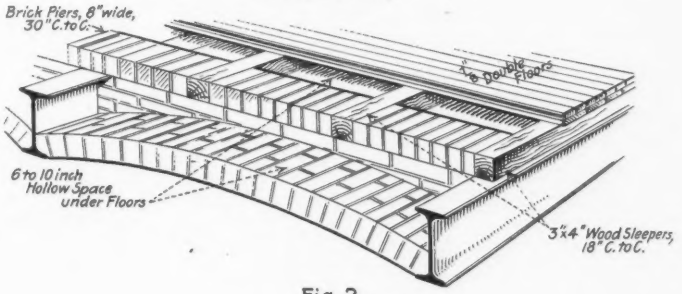


Fig. 2.
Brick Arch, Upper Stories
(Cedar St. Side of Building.)

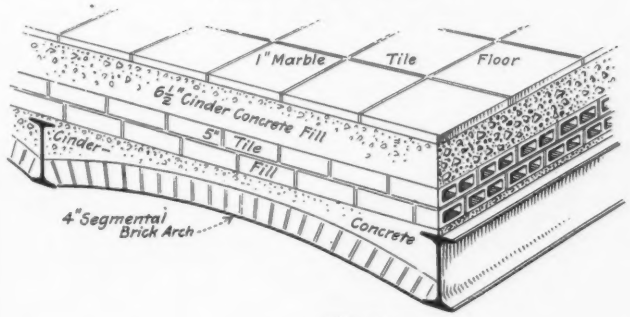


Fig. 3.
Arches in Corridor near Elevators.
(Upper Floors, Cedar St. Side.)

Types of Floor Arches

building the floor arches were of hard burned terra cotta 10 inches deep, side construction. Arch spans varied from 3 to 5½ feet, the average span being 5 feet. The material and workmanship of the arches appears to have been very good.

On the Cedar Street side of the building four-inch segmental brick arches having a rise of four to six inches at the center of the usual five-foot span were used between the floor beams. Various means were employed to support the double wooden floors. In some cases a cinder fill was used between the sleepers and in other cases brick piers running across the arch supported them, a large hollow space being left under the floor boards. Some of the arches in this section are exceptionally heavy, being twenty inches deep, of brick, concrete and hollow tile. (See Plates 3 and 4.)

Damage. In the stories from the fifth up, the wood floors were entirely consumed. Even the wood sleepers between the terra cotta tile filling were burned, leaving only a row of nails in channels between the blocks. Below the fifth the flooring and sleepers were generally destroyed except those points reached by fire department streams.

The terra cotta and brick arches withstood the fire well—no evidence was found of any arches having failed. The spalling of the lower web of terra cotta arches was very rare, except in the basement where the heat of the burning insulation on the telephone, telegraph and similar wires was intense and the terra cotta was badly spalled.

Roof. The main portion of the roof was surfaced with ordinary brick over waterproofing on a heavy cinder fill on arch construction and supports similar to floors. From this flat portion a mansard sloped down to the level of the sixth floor. This mansard was constructed of an unprotected steel framework, with three-inch cinder plaster blocks between tees and covered on the outside with waterproof paper and slate.

Damage. On the Broadway and Cedar Street corner the roof with the floors fell through to the basement, taking the mansard with it. The portion of the mansard remaining on Broadway, Pine and Cedar Streets has fallen slightly inward, due to the bending of the roof beams and buckling of the columns. The cinder plaster block filling between the tees stood the heat well and in nearly all cases is intact where the mansard did not collapse.

Structural Metal Work. Beams and girders were of wrought-iron and steel 6 to 15 inches in depth, weight not ascertainable, supported by cast-iron columns, ranging (according to specifications) from 6 inches in diameter by three-fourths inches in thickness of metal on the top story to 14 3-8 inches diameter by 1 3-8 inches in thickness in the basement, except wrought-iron Phoenix segmental columns were used on the Pine Street side of main building up to the fourth floor; on the Cedar Street side some box columns built of two 6-inch wrought-iron channels and two to four plates were used from the third to the eighth floors.

The webs of the beams and girders were protected by the arch con-

struction, but no fireproofing was applied to the lower flange nor to the columns, except that a few columns at the Nassau Street end were partly enclosed in four inches of terra cotta; this, however, was done only for decorative effect.

PLATE 4

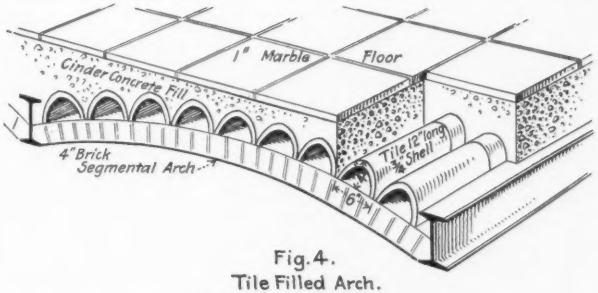


Fig. 4.
Tile Filled Arch.
Corridor near Elevators, Lower Floors
Cedar St. Side of Building.
Arch 12" thick at Center.

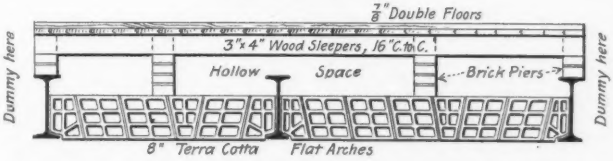


Fig. 5.
Section through Floor of Dumbwaiter Shaft.
(Similar Construction Used for Floor of Roof Structure)

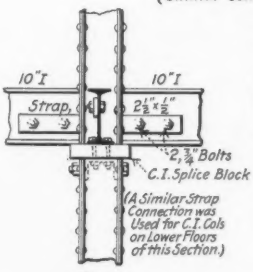


Fig. 6.
Connection to Wt Iron Columns.
Cedar St. Section.

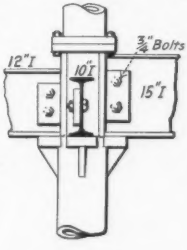


Fig. 7.
Connection to C.I. Columns.
Pine and Broadway Sections.

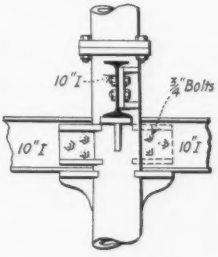


Fig. 8.
Connection to C.I. Columns.
Cedar St. Section.

Types of Floor Arches and Column Connections

Damage. In the Pine Street side of the building there is no apparent damage to beams, girders and columns up to the sixth floor; above that level the beams and girders are deflected and many columns are buckled, especially on the seventh and eighth floors at the Broadway end.

The Nassau Street end of the building shows little or no deflection of beams and girders; the columns, due to the ornamental covering of four-inch hollow tile, are intact.

In the Cedar Street part of the building (built 1869) beams and girders were found to be deflected very generally and columns buckled or broken above the fifth floor. The wrought-iron column "C" at the northeast corner of light well "N" (see Plate Nos. 2, 15 and 16) shows a partial failure. But all other wrought-iron columns appeared to be in good condition.

It was entirely in this original section that the two smaller collapses occurred, and likewise the greater part of the main collapse. In fact all the collapses appear to have started at the light shafts. Some of the remaining cast-iron columns are fractured entirely across, in others the cast-iron brackets supporting the beams are cracked or partly broken off —in a number of cases the column is cracked about the bracket instead of the bracket itself being broken. In other cases the brackets are deflected without any fracture showing softening and bending in of the column. The columns appear to have been very defective, due to the shifting of the core during casting, making one side of column very much thinner than the other. The column shown in Plates 12 and 13 is only about an eighth of an inch thick on one side and one-half inch thick on the other and the cracked column across the light court (see Plate No. 14) shows similar weakness. A column in the collapsed section near the main stairs shows the metal to be five-eighths inch thick on one side and one and one-half inches thick on the other.

The condition of the remaining cast and wrought iron columns indicates beyond much doubt that the initial collapse in each case was due to the failure of one or more cast-iron columns.

Floor Openings—Stairways. In this building, covering a whole block, there was but one continuous stairway from the grade to the eighth floor and this opened to hallways enclosed only by tile and thin glass partitions. These stairs had iron frames and risers with marble treads. Neither in this nor in any other stairs in the building were the treads supported by iron or steel plates as is customary in modern practice. The stairs were not badly damaged except at the fifth floor where the collapse of the adjoining section carried away a landing. The marble treads in a few places are broken and split, but this was not general.

In addition to this main stairway there were various others which in most cases were widely separated and connected only two floors; they were mostly fireproof except the wooden stairway between the fifth and sixth stories in the Lawyers' Club.

PLATE 11

Main Collapse looking South toward Pine Street from No. 128 Broadway

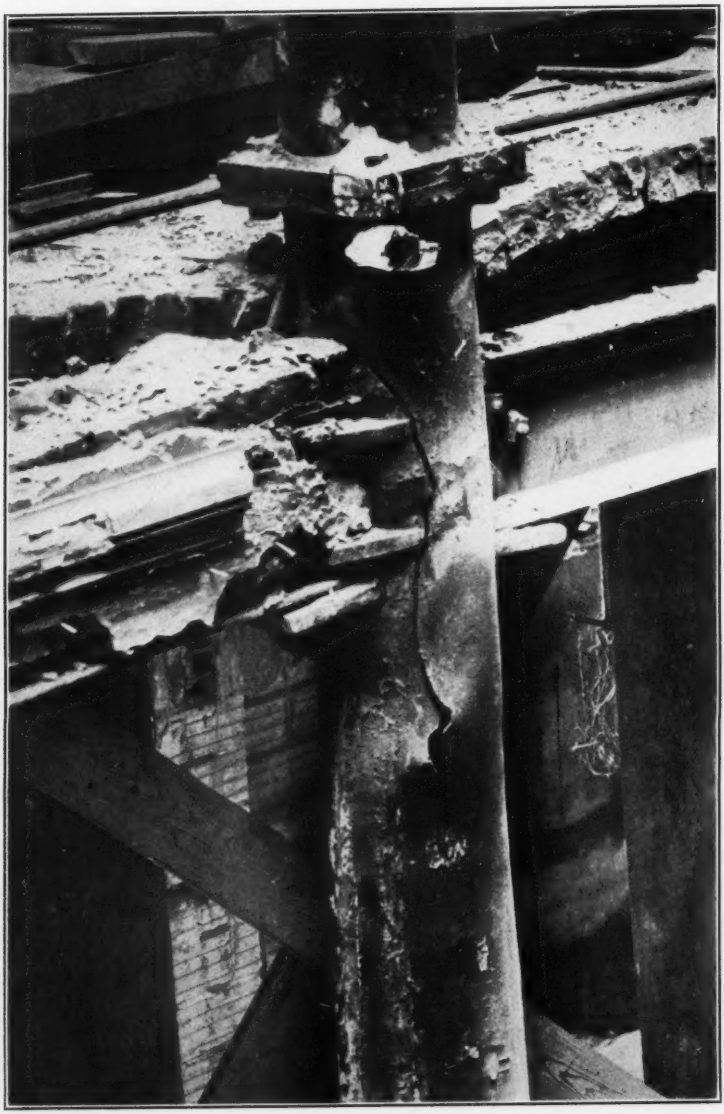
PLATE 12

General View of Light Shaft "O" and Fractured Cast Iron Columns "A" and "B"—see Plate 2. The Construction of the heavy Floor Arch in left of picture is detailed in Figure 3, Plate 3

PLATE 13

Cast Iron Column "A" standing at Light Shaft "O"—see Plate 2. Detail of Fracture at Seventh Floor Level, showing Thickness of Metal one-half inch on One Side and one-eighth inch at Opposite Side

PLATE 14

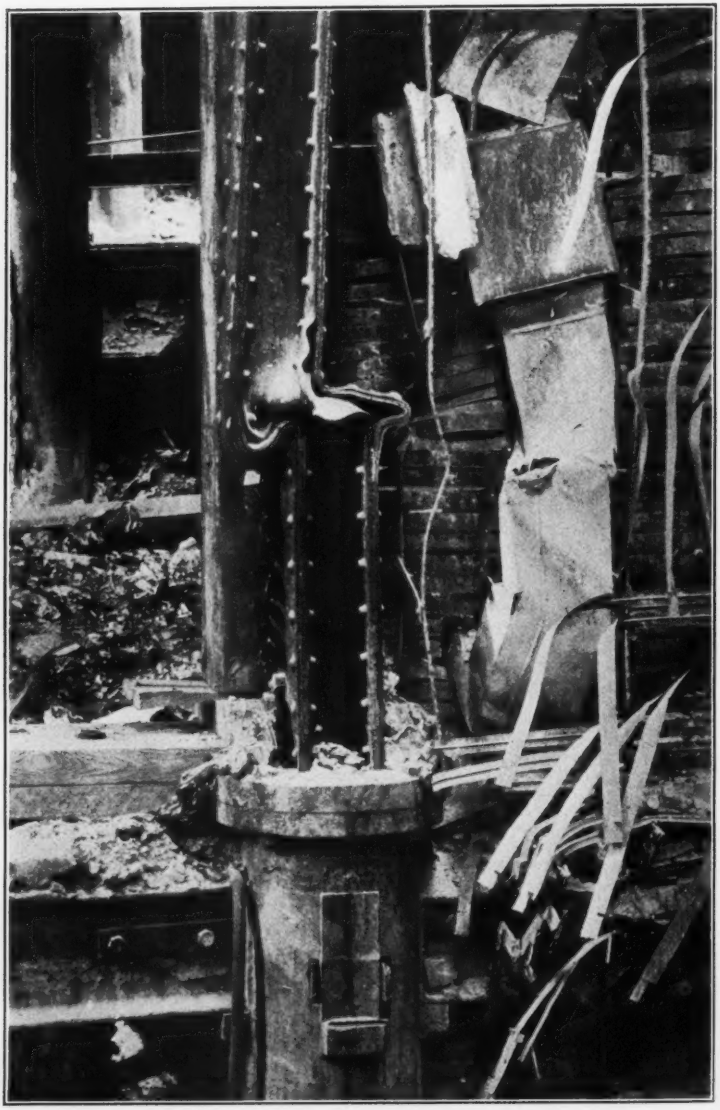


Cast Iron Column "B" standing at Light Shaft "O"—see Plate 2. Detail of Fracture at Seventh Floor Level and Deflected Brackets due to Softening of Metal. Also shows One Method of attaching Beams to Columns. Thickness of Metal at Fracture about one-fourth inch

PLATE 15

Beams—Metal Stud and Lathing of Partitions and Light Shaft Enclosure (apparent Fissure in Cast Iron Column is in Plaster Covering)

PLATE 16



Partial Failure of Wrought Iron Column "C," Third Floor, at Light Shaft "N"—see Plate 2. Note the Method of Fastening Wrought Iron Beams to Cast Iron Columns by Wrought Iron Straps Passing through Column

PLATE 10

Interior View of Main Collapse looking North toward Cedar Street, showing Debris on top of Safe Deposit Vaults. The floors above the Security Vault of the Equitable Life Assurance Society are shown standing in left of picture

Elevators. There were eight main elevators with heavy hard wood cars enclosed in four shafts of 16-inch and 20-inch brick but with wood doors hung to wood trim. Upper panel of doors and space above consisted of open iron grille work. It is evident that the fire swept through these shafts, for the doors and frames are burned away entirely on all floors above the first, and the interior brick work is spalled, indicating intense heat.

There were also two elevators opposite the main stairway. The doors and trim are intact up as far as the fourth story, showing that these took little or no part in the spread of the fire.

One elevator ran in a shaft of four-inch terra cotta with wood doors, from the second to the ninth floors at the Broadway end of the building.

Dumb-waiters. There were two elevators and a battery of eleven dummies arranged around the sides of a four-inch terra cotta shaft—with a platform of wood floors on steel beams and terra cotta arches in the center. There were large hollow spaces under the wood floors. (See Plate No. 4, Figure 5). A wood framework ran around the platform partly enclosing the dummies. This shaft connected the Cafe Savarin kitchen on the eighth floor and roof structure with storerooms in the basement, the restaurants and dining rooms on the grade and first, and the Lawyers' Club on fifth and sixth.

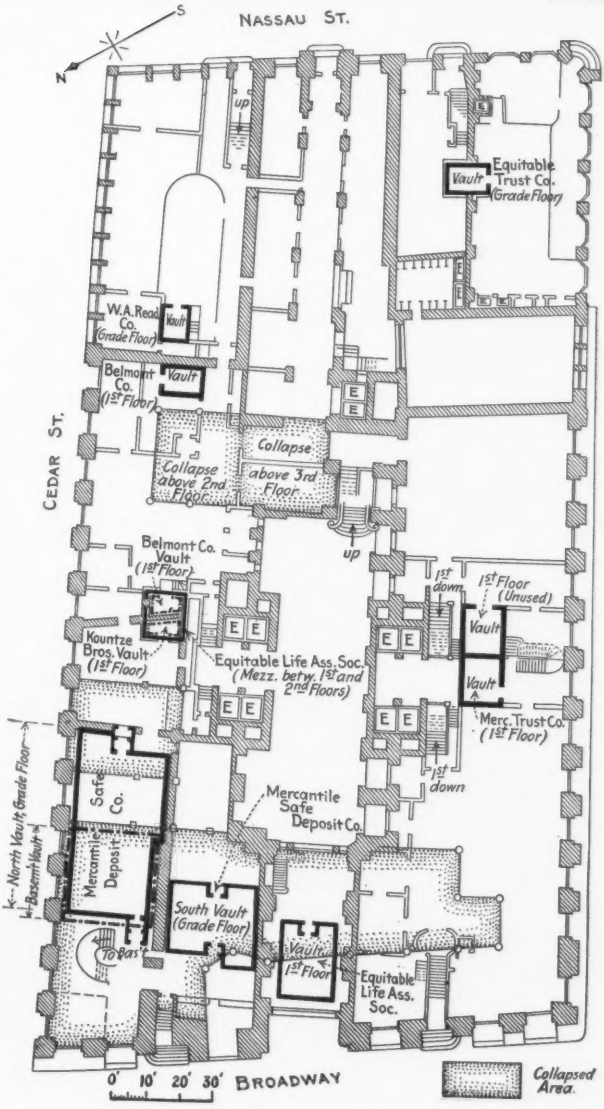
It was through this shaft that the fire spread rapidly from the basement to the upper stories of the building. The dummy shaft shows every sign of severe heat. The beams are bent and twisted and the arches are cracked and broken. Hardly a vestige remains of the wood framework within, nor of the wood doors to the shaft.

All the main shafts were open to the basement, so that the conditions were propitious for a fire starting in the basement, as this one did, to spread with a surprising rapidity through the building.

Light Shafts. In addition to the above shafts there were on the Cedar Street side four large light shafts from the fourth to the roof. The nearest two to Broadway were constructed of plaster on metal lath, the others of four-inch hollow cinder plaster blocks for a height of six feet above the floors and the balance filled with thin glass in wood sash and frames. These shafts not only assisted in the spread of the fire from floor to floor but caused it to burn simultaneously on all floors, allowing an accumulated effect of heat, to which may be attributed the more complete destruction of this side of the building. Floor collapses occurred adjoining three of these four shafts and the two broken columns shown in Plates 12, 13 and 14 are alongside the other shaft at which a partial collapse occurred, but was limited to one panel on the seventh floor.

Vent Shafts. Adjoining each pair of main elevators were two vent and pipe shafts enclosed in twenty and sixteen inches of brick with small openings to floors. As far as could be ascertained they took no part in the spread of the fire.

PLATE 5



Plan showing Location of Vaults

Partitions. Part of the partitions were of four-inch terra cotta extending from floor to ceiling, others had a tile base with wood and glass above, while some were entirely of wood. On the Cedar Street side some four-inch hollow plaster blocks were used; likewise some metal lath and plaster partitions. All doors were of wood, or wood with thin glass sash. Hardwood trim was used exclusively and was of a massive design. The large quantity of combustible material in the partitions furnished fuel for the flames. Few partitions in the building had any value as fire stops.

Damage. Tile partitions extending from floor to ceiling were mostly in position after the wooden door frames burned away. The tile bases of partitions having wood and glass tops were damaged by the warping of the channel iron door bucks. The metal lath and plaster partitions were mostly destroyed and the plaster block partitions were considerably damaged.

Finish. In the more ornamental parts of the building, such as the Equitable offices, the Mercantile Trust Co. offices, and the Lawyers' Club, plaster, stucco and marble were extensively used. This finish was damaged or destroyed by the fire. The ceilings generally were plastered directly on the soffits of the floor arches, but in the Insurance Library, the Equitable offices, part of the Lawyers' Club and a few other locations there were ornamental ceilings of plaster on wire mesh suspended on a framework of wood. (See Plate No. 19.)

VAULTS.

It is estimated that securities and other valuables to the amount of approximately one billion dollars were contained in the vaults of this building. The principal vaults are briefly described as follows:

Mercantile Safe Deposit Co.: The large vault in basement containing safe deposit boxes is 30 x 25 feet in area. The sides are of 24-inch granite, top of vault is formed by the building floor arch above, two of the cast-iron columns of which pass through the vault. The lining is of 3-inch steel. This vault is covered by another on the grade floor except 3½ feet at west end where there is a 3-inch steel plate over the building floor arch to protect it. The vault foundations rest directly on earth. There are two vestibuled entrances; the outer doors are 5 and inner doors 3 inches thick; both of laminated steel, made of 1-inch plates. **Damage:** The vault was not exposed to any fire. There were about 4 inches of water on floor and water seeped freely through from vault above. The box tiers were wet but there was no water in depositors' inner boxes except the ones near floor which were immersed in water. The wreckage of the main collapse fell on the 3½ feet of top not covered by the upper vault; no damage resulted.

There are also **16 small vaults in basement,** the average size being 8 x 10 feet and 7 feet high. The sides, top and bottom are of laminated steel ranging in thickness from about 1½ to 3 inches. Doors part vesti-

PLATE 19

Wood Paneled Walls shown to right also Terra Cotta Furring made of Plaster on Wire Lath over a Wooden Frame.
Insurance Library on Gallery Floor, showing Collapse of False Ceiling

buled and part single; average thickness 3 to 4 inches. Some vaults contained safe deposit boxes. In some cases a single firm leased an entire vault. **Damage:** None were exposed to fire. Water entered a number of these vaults.

The **north vault on grade floor**—the largest in the building—is 28 x 58 feet in area and contained safe deposit boxes. The sides are of laminated steel made of 1-inch plates screwed together with no air spaces: the steel is 4 inches thick where the vault is against a brick building wall and 8 inches thick elsewhere. The top is of 7-inch laminated steel supported by short 7-inch cast-iron columns bearing on 1-inch cast-iron plates resting on the tiers of safe deposit boxes; also by collars fastened to the four cast-iron building columns which pass through the vault. The top is about 1 inch below the ceiling of this story. The vault rests on the building floor arch which is covered by 2 inches of concrete on a 1-inch steel plate, except that the portion not over the basement vault has 1½ inches of concrete on a 1½-inch plate; the floor under this portion is also reinforced by a few I-beams supported by cast-iron columns. There are two vestibuled entrances, each having three doors of steel; thickness of outer doors 12 inches, middle 9 inches, inner 5 inches. **Damage:** The vault was exposed to but little fire except the heat of the wreckage of the main collapse, all floors and roof having fallen on the 7-inch laminated steel top, which deflected about 2½ inches. When the debris was removed the deflection decreased, as the top sprung partly back to its original position. Large quantities of water were promptly thrown on the debris over the vault to cool it. Water seeped through and was about 2 inches deep on the floor when the vault was first opened. The outer boxes were wet but the inner boxes of depositors are said to have been dry.

The **south vault on grade floor** containing safe deposit boxes is 21 x 27 feet in area. The sides, top and bottom are all 3 inches thick of laminated steel made of 1-inch plates screwed together. The top is supported only by the shell formed by the sides and is 27 inches below the ceiling of this story. The vault is supported independently of the building on a platform of 15 and 8-inch wrought-iron I-beams on 6-inch wrought-iron box columns on stone and concrete foundations resting on the ground. All metal work unprotected. There are two vestibuled entrances: doors of steel, the outer 6 inches and the inner 4 inches thick. **Damage:** The vault was exposed to but little fire except the heat of wreckage in main collapse which was promptly wet down. All floors and roof fell on the 3-inch steel top, which deflected 4¼ inches until it rested on the tiers of safe deposit boxes, but there was no serious damage to contents. Considerable debris still remains on this vault and the deflection of the top has not changed. Water freely entered the vault and was about 7 inches deep on floor. The box tiers were wet but the inner boxes of depositors are said to have been dry except the lower ones which were immersed in water.

The Equitable Life Assurance Society: The **main vault on first floor,** near front wall and immediately over corridor at Broadway entrance, is

18 x 23 feet in area. The sides, top and bottom are each 3¾ inches thick of laminated steel made of 1-inch plates screwed together. The top is supported by the sides and one 6-inch cast-iron column in center fastened to the steel floor. The top is 2 feet 8 inches below the ceiling of this story. The vault rests on 15-inch, 90-100-pound steel I-beams 4 feet 2 inches between centers, supported above building floor on masonry piers. There is one vestibuled entrance; doors of steel, the outer 7¼ inches and the inner 4¼ inches thick. There is also a small emergency door on top. The vault contained securities. **Damage:** One end of the vault was exposed to a moderate heat. Some of the wreckage of the main collapse struck the top at the east end only; the floors over the balance of the vault did not collapse. There was no damage inside except considerable water seeped in.

The Equitable Trust Co.: The area of the security vault on first floor is 9 feet 10½ inches by 12 feet 11½ inches and 7 feet 8½ inches high. The sides, top and bottom are each 3¾-inch steel; the brick building wall extends around part of vault. The top is supported by the sides. The vault is supported independently of the building on a platform of 15-inch, 80-pound steel I-beams, 3 feet between centers, on steel box columns, on a base resting on earth. There is one vestibuled entrance with doors of steel, the outer 6¼ inches and the inner 4¼ inches thick. **Damage:** There was no fire near the vault. Some water seeped in but the damage is said to have been small.

Minor Vaults: There are also about **seven small vaults** on the lower floors as shown in Plate No. 5. Their average size is approximately 100 square feet. Most of them are alike, having sides, top and bottom of laminated steel 2 to 3 inches thick. None were exposed to more than moderate heat and their contents suffered no damage other than by water.

There were **two 4-inch tile vaults.** One on the fourth floor at the Broadway end having a ¼-inch metal lining, was partly carried away by the main collapse and the contents were destroyed. The other, located on the third floor at the Cedar Street side, had no lining and just escaped the main collapse. The exposure to heat seems to have been moderate and the damage to the vault was nominal; condition of contents not determined.

Safes: There was a large number of ordinary portable safes having an insulating filler of concrete ranging from 2 to 5 inches thick. Most of them were exposed to the severest heat of the fire and many went down with the wreckage when the three separate floor collapses occurred. The contents of nearly all showed some effects of the heat, while in an appreciable number of the safes the contents were practically destroyed.

Loss of Life.

As far as is known, six persons lost their lives in the fire.

Three employees of the Cafe Savarin, whose escape was cut off by the fire, jumped from the northwestern corner of the roof to Cedar Street and were killed.

Battalion Fire Chief Wm. Walsh was killed in the building near the

main stairway on the 4th floor by the collapse of the floors near the stairway.

Two watchmen of the Mercantile Safe Deposit Co., John Campion and Frank J. Niedler lost their lives at the Broadway and Cedar Street corner of the building when the floors at that location collapsed.

It is fortunate that the fire occurred at a time when the building was practically unoccupied or the loss of life might have been far greater, due to inadequate facilities for escape and the early collapse of the cast-iron columns.

Conclusions and Recommendations.

The following comments bearing upon the spread of the fire and its consequences cover the chief points of interest.

1. Floor Openings: The unprotected floor opening maintained its bad reputation and played the most prominent part in this fire by making possible the quick and destructive spread of the flames from the small receiving room in the basement to all the upper floors. The use of a few fire doors at the communications with the dumb-waiter shaft would have confined the fire to the shaft and left the balance of the building with little or no damage. So much has been said of the importance of protecting all openings which pierce floors that nothing remains but to strongly reiterate and emphasize the point here. Fortunately the importance of this feature is now generally recognized, and in New York City but few new buildings, even for office occupancy, are now erected without fire stops at stairs, elevators and other floor openings. **It is essential, however, that more of the existing buildings, having these features, should be provided with better protection at floor openings. In most cases this can be done conveniently and at relatively small cost.**

2. Height: The height of fireproof buildings should be limited by the adequacy of the fire protection, both public and private. In other words, no building should be over 50 feet or four stories high without some or all of the following fire protection features: automatic sprinklers; smokeproof stair towers in combination with standpipe equipments; fire stops at all floor openings; one or more interior fire walls; ample stairways and other approved means of exits; protection against exposing buildings.

3. Area: The corridor partitions in every fireproof office building should be effective fire stops, utilizing fire doors; any glass if used in transoms should be wired glass. Single offices containing large areas should be subdivided by fire partitions intended to at least retard the spread of incipient fires; if necessary, wired glass may be used in their construction. Where large numbers of persons are employed such fire retardants are essential for the protection of both life and property. In fact, all floor surfaces, doors, room partitions, window frames, sash and other trim, and even office furniture should be of incombustible material in all fireproof buildings.

There has probably been a tendency to regard large unbroken floor areas as dangerous only in buildings of mercantile and manufacturing occupancy. In this office building the large unbroken floor areas of the principal occupants, together with the use of wood and glass corridor partitions above a tile base, on the floors containing the smaller offices, contributed to the spread of fire as effectually as the dumb-waiter shaft, light wells and other floor openings.

4. Restaurants: Restaurants with the kitchens, store rooms and large unbroken floor areas incident thereto introduce a serious fire hazard disproportionate to that of the usual office building occupancy.

Approximately 55,000 square feet of floor area in the Equitable Building was devoted to restaurant purposes.

Among the most dangerous features commonly found in restaurants are the flues for ranges and removal of grease laden fumes from the kitchen, also floor openings such as dumb-waiter shafts and the like. The protection of the range and ventilating flues should be equal to that of boiler stacks. The dumb-waiters should be in fireproof enclosures with fire doors at all openings.

The fire started in the receiving room of the restaurant in the basement and spread by way of the dumb-waiter shaft to the dining rooms and kitchen on the upper floors. The latter by reason of their size and combustible contents enabled the fire to get beyond control.

5. Sprinklers: All portions of office buildings where fire is most likely to occur and spread, such as in basements, kitchens, store rooms, large areas, record rooms, etc., should be equipped with automatic sprinklers. Perforated pipe systems should be prohibited.

6. Stairways and Exits: No building should have less than two stairways remote from each other and enclosed in fireproof shafts with fire doors at communications to floors. Additional stairways should be provided when necessary so that no point on any floor will be more than 90 feet from a stairway. Other approved means of exit such as protected openings through fire walls may replace to advantage one or more stairways. Revolving doors if used should be in addition to the necessary exit doors.

There was only one continuous stairway in the Equitable Building. The fire soon cut off access to it on the upper floors, and the first collapse of the floors carried away part of the stair landing. Had the fire occurred during business hours the loss of life would probably have been appalling. As it happened, three persons on the upper floors were trapped. They jumped into Cedar Street and were killed.

7. Standpipes: The extent to which the standpipes were used in the numerous tall buildings facing the Equitable Building across narrow streets, shows a laudable realization on the part of the Fire Department of the futility of fighting fires above 50 feet or the 4th story by hose streams directed from the streets, especially during a high wind.

It is apparent from personal observations and from the records that

hardly a hose stream was directed at the fire from the street level except a number of streams used chiefly to wet down the vaults after the fire was under control.

The futility of constructing standpipes less than 6 inches in diameter in any building was clearly evidenced in this fire. In buildings over 150 feet high they should be 8 inches. A considerable number of the standpipes in nearby buildings are only four inches. The inefficiency of these small standpipes, as compared to those 6 inches in diameter, was strikingly manifested in the character of the streams taken from them.

8. Portable Steamers: The inefficiency of the ordinary portable steam fire engine was strikingly apparent in contrast with the high pressure streams from the separate fire main system. The fluctuations in pressure incident to stoking the boilers of the portable steamers is an element of weakness as well as their capacity and pressure limitations.

9. Smokeproof Towers: This fire furnished further evidence of the fact that the Fire Department cannot be expected to fight fires effectively above the 5th floor of buildings except by means of smokeproof towers and six-inch or larger standpipes conveniently accessible thereto.

In most cases the high wind turned the streams, even when directed from the standpipes of buildings across 35-foot streets, into spray before they reached sufficiently far to penetrate appreciably within the windows of the burning building.

10. Cast-Iron Columns: Cast-iron columns were again shown to be inferior to wrought-iron or steel. There were three separate and distinct collapses of portions of the floors and the initial collapse in each case was apparently due to the failure of the unprotected cast-iron columns. Plates 12, 13 and 14, show two cast-iron columns broken and part of the 7th floor adjacent thereto has collapsed. This photograph calls attention to a serious weakness of cast-iron columns often pointed out before: the uncertainty of the thickness of the metal. The broken column (plate 13), shows a thickness of metal at the fracture varying from about ⅛ to ½ inch, while for a safe column the minimum thickness should never be appreciably less than 1 inch. Plate No. 16 demonstrates again that wrought-iron and steel when heated to excess fail only partially or at least slowly in contrast to cast-iron columns. The difficulty of securing a satisfactory connection of the cast-iron columns with the beams and girders was also experienced. Some cast-iron brackets broke and others deflected due to the softening of the column.

11. Fireproofing: The fireproofing on the structural metal work of fireproof office buildings should be substantially the same as for mercantile and manufacturing buildings. There are usually one or more stories containing an appreciable quantity of highly combustible material such as records, stationery supplies, store rooms, restaurants and stocks of merchandise on the grade or other floors. Accumulation of office furniture and equipments added to combustible trim and finish also make intensely hot fires, as in the case of the Equitable Building. **It is not safe to assume that the opportunity of a quickly spreading fire will be absent in office buildings.**

The deflection of wrought-iron beams with only their lower flanges unprotected was general at points where the heat was most intense. The unprotected cast-iron columns in the presence of so much combustible material were no better than if made of heavy timbers. The best protection against both fire and corrosion is a steel column solidly embedded in concrete, using neat cement in contact with the metal.

12. Floor Arches: The brick floor arch again demonstrated its reliability and stood the heat remarkably well. Unfortunately its weight prohibits its use in high buildings. It is possible that the weight of the brick arches helped to hasten the collapse of the unprotected cast-iron columns. Brick arches were used in all portions where collapses occurred, except south end of main collapse.

The 10-inch tile floor arches used in this building made a good showing. Scarcely any of the tile was cracked off the lower web of the arch, except where exposed to the heat of the burning insulation on telephone and telegraph wires. Elsewhere the temperature developed was appreciably less than in some other serious fires. The burning of the insulation on wires in the distributing room of the telephone building at Baltimore produced the most intense heat in the general conflagration in that city.

13. Vaults: Public safe deposit vaults and others intended to practically guarantee the safety of their contents against damage of any kind should be designed to provide positive protection against fire, water and impact.

Such a vault should embody the following characteristics:—

An outer casing of concrete at least 12 inches thick to insulate against heat and so reinforced with steel as to have ample strength to resist impact. The foundations should rest directly on the ground and be of masonry or of structural steel designed with a large factor of safety. The steel to be fireproofed with reinforced concrete at least 6 inches thick. The foundations as well as the floor, roof and sides of vault should be independent of the building structure.

There should be an inner shell of steel, at least 1½ inches thick, provided with sufficient clearance so that any moderate deflection of the outer casing would not crush it. The outer masonry casing and the inner steel shell should be waterproofed; likewise the vestibuled doors should be so stepped and packed as to prevent smoke or water from entering.

14. Safes: Ordinary portable safes with sides made of a heavy iron shell filled with at least 5 inches of cement afford a good degree of protection under average conditions. They do not, however, assure the safety of their contents against damage by fire under severe conditions.

A considerable number of safes did not fully protect their contents in this fire; in the Baltimore and San Francisco conflagrations the majority of them failed.

Meters for Fire Service

By Gorham Dana (Member N. F. P. A.)

The problem of metering water for fire service is one of quite recent origin but of growing importance. So long as fire service pipes are used for fire purposes only, there would seem to be no more reason for metering them than for metering connections to public hydrants. Of late years, however, the number of fire service pipes has increased very rapidly and there have been cases where water was taken from such pipes for other purposes. Again, many of the large mills have extensive systems of underground pipes, and it is not infrequent that leaks of considerable size will develop in such systems which may exist for some little time before being discovered.

The water companies or departments have naturally objected to water being lost in these ways, and in several localities have passed rules that all fire pipes be metered. This custom will probably grow, especially in cities where water is scarce or is pumped at considerable expense.

It is the Underwriter's duty to see that the fire protection in the property he insures is maintained in the highest state of efficiency and that no device is introduced that will impair its value. It is for the best interests of the community, also, that this be done, for it is only through such vigilance that the enormous fire waste of the country can be kept down. The loss of a little water through fire mains is of slight consequence compared to the burning of a valuable mill upon which the welfare of a town may largely depend; and if it can be shown that certain types of meters are liable to cripple a fire protection system by clogging or excess of friction loss, the general public should co-operate with the insurance interests in seeing that such devices are not used.

It has been conclusively proven that most of the old types of meters in use for domestic service are detrimental to fire protection, and it is only recently that new devices have been put upon the market that are suitable for this purpose.

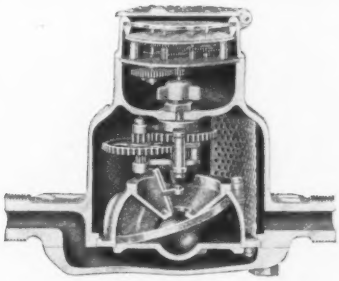
A short description of the more important of the older types of meters is desirable before explaining the recent developments.

Types of Meters.

There are five principal types of meters in common use:—

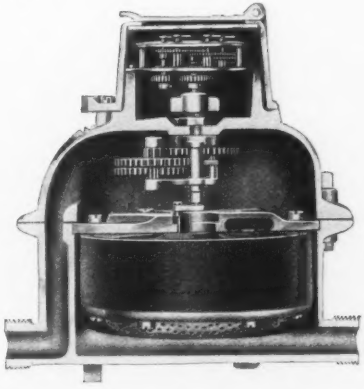
(1) **Disc Type.** This depends on the oscillation of a disc, usually of hard rubber shaped like the segment of a hollow sphere. This is a positive

displacement meter and is perhaps the most accurate type, but the friction loss is large.



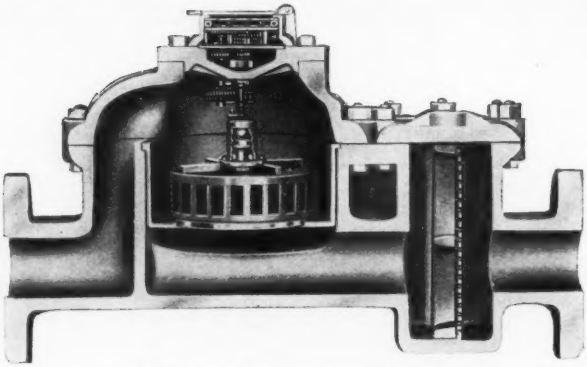
Disc Meter (Sectional View)

(2) **Rotary Piston Type.** This depends on the rotation of a piston, usually made of hard rubber. In some makes there are two revolving pistons fitting together as do the buckets in a rotary pump. In other makes an irregular shaped piston rotates in a cylinder of similar shape but larger size. This is a positive displacement meter of about the same accuracy as the disc type and creating somewhat more friction loss.



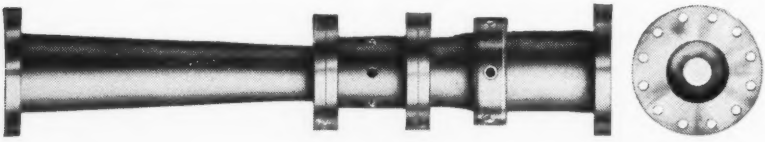
Rotary Piston Meter (Sectional View)

(3) **Reciprocating Piston Type.** This is built somewhat on the principle of the steam end of a steam pump. There are but few meters of this type made and, as might be supposed, the friction loss is very great.



CURRENT METER (Sectional View)

(4) **Current Type.** This is built somewhat on the principle of a water wheel, the wheel usually being of hard rubber and revolving on a vertical axis. This type is somewhat less sensitive than any of those previously mentioned and the friction loss is decidedly less.



VENTURI METER

(5) **Venturi Type.** This depends on the principle that when water passes through a contraction in a pipe or a throat the velocity is increased but the pressure is reduced. The meter consists simply of a casting similar to a pipe casting, rapidly decreasing in diameter until the throat is reached and then more gradually enlarging to normal size. The difference in pressure at the throat and in front of the meter is taken and is used to actuate the registering device. The registering device is, however, very complicated and expensive and has to be kept in a dustproof case under frequent inspection. "The registering device alone costs about $400 for the smallest size. The meter is made in sizes from 2″ to 17 feet in diameter but the sizes less than 6″ are generally not economical as compared with other types of meters. Each size is designed with different diameters at the throat to care for different conditions and is quite accurate for the range for which it is designed. Friction loss is smaller than that of most any other type, except the Hersey Detector and some of the current types. It is particularly adapted for low velocities and large volumes. Also for measuring hot water, sewerage, etc., which would clog or corrode most types of meters."

Makers and Makes.

The principal makers are as follows:

Hersey Manfg. Co., 314 W. 2d St., South Boston, Mass.
Hersey Disc, Hersey Rotary, Hersey Torrent, Hersey Detector.

National Meter Co., 118 Chambers St., New York City.
Crown, Empire, Nash, Gem, Premier.

Pittsburg Meter Co., East Pittsburg, Pa.
Keystone, Eureka.

Union Water Meter Co., 33 Herman St., Worcester, Mass.
Union Rotary Piston, Nilo.

Neptune Meter Co., 142 Martin St., Newark, N. J.
Trident, Trident Crest Meter.

Thompson Meter Co., 79 Washington St., Brooklyn, N. Y.
Lambert Meter.

Builders Iron Foundry, Providence, R. I.
Venturi Meter.

Henry R. Worthington, 114 Liberty St., New York.
Worthington Duplex Piston, Worthington Disc, Worthington Turbine.

Standard Water Meter Co., 245 Robinson St., Brooklyn, N. Y.

TABLE 1.—COST OF METERS.

Disc Type	1 inch meters cost about	$16
	4 inch meters cost about	175
	6 inch meters cost about	375
Rotary Piston Type	1 inch meters cost about	30
	4 inch meters cost about	250
	6 inch meters cost about	500
Reciprocating Piston Type	4 inch meters cost about	250
	6 inch meters cost about	550
Current Type	4 inch meters cost about	160
	6 inch meters cost about	350
	8 inch meters cost about	650
Venturi Type	6 inch meters cost about	570
	8 inch meters cost about	600
Detector Meters (F. M. Type)	4 inch meters cost about	175
	6 inch meters cost about	385
	8 inch meters cost about	660

Tests of Meters.

The most important tests on large sized meters have been made in the following places:—

At Naumkeag Cotton Mills, Salem, July, 1896, and at Philadelphia, August, 1897, by E. V. French of the Associated Factory Mutuals (see records of New England Water Works Association, December, 1897).

Knoxville, Tenn., by Frank C. Kimball, superintendent of Knoxville

Water Works, 1903 (see Transactions of New England Water Works Association, September 9, 1903).

Burlington, Vt., by F. H. Crandall, superintendent of Water Works (see Transactions of New England Water Works Association, June, 1904).

Lowell, Mass., 1904–1905, by the Lowell Water Department, report by William F. Sullivan, assistant engineer (see paper read before the New England Water Works Association, March 8, 1905).

Elaborate testing arrangements were installed for all these tests, but a detailed description will not be attempted here. The test house at Lowell is one of the most complete, and being indoors can be used at any time of the year.

Tests have also been made at the Hersey Manfg. Co. factory.

The following is a summary of the results of these tests:—

TABLE II.—METERS ARRANGED BY TYPES, SHOWING FRICTION LOSS AND SENSITIVENESS.

(Compiled from tests made by E. V. French of the Associated Factory Mutuals, 1896–1897; Frank C. Kimball, Knoxville, Tenn., 1903; and tests by the Lowell Water Department in 1904 and 1905.)

Type.	Name.	Maker.	Size inch.	Gallons flowing.	Loss of pressure in lbs.	Unrecorded flow. Size of openings, 1/16 in.	1/4 in.	1/2 in. Per cent.
Disc	Hersey	Hersey Manfg. Co.	6	1,000	24.8 K	54	2.5	2
	Lambert	Thompson Meter Co.	4	500	12.9 F			
	Keystone	Pittsburg Meter Co.	6	1,000	13.4 K		9.3	10.7
Rotary Piston	Hersey	Hersey Manfg. Co.	4	500	40.0 F			
	Hersey	Hersey Manfg. Co.	6	1,000	47.8 K			4.1
	Crown	National Meter Co.	4	500	31.2 F			
	Crown	National Meter Co.	6	1,000	38.2 K	50	2.9	1.3
	Union	Union Meter Co.	4	500	6.4 F			
	Union	Union Meter Co.	6	1,000	5.6 K		28	2.1
	Empire	National Meter Co.	6	1,000	33.2 K	57	1.4	2.7
Current	Gem	National Meter Co.	4	500	4-1 F			
	Gem	National Meter Co.	6	1,000	4.0 K		50	1.9
	Torrent	Hersey Manfg. Co.	4	500	8.1 F			
	Torrent	Hersey Manfg. Co.	6	1,000	8.7 K		48	4.3
	Trident Crest	Neptune Meter Co.	4	260	5.5 E			
	Standard	Standard Water Meter Co.	6	1,000	2.7 K			36.5
Reciprocating Piston	Worthington	H. R. Worthington	3	300	48.0 F			
Venturi	Builder's Iron Foundry		12	4,000	4 (5″ throat)			
			12	4,000	1.5 (6″ throat)			
By-passed Check	Hersey Detector Meter, D. M.	Hersey Manfg. Co.	6	1,000	1.1 H			
	Hersey Detector Meter, F. M.	Hersey Manfg. Co.	6	1,000	1.0	0 to 5		

F.—Tests by E. V. French. K.—Tests by F. C. Kimball. S.—Tests by W. F. Sullivan. E.—Test by East Jersey Water Co. H.—Hersey Manfg. Co. factory.

Objections to Old Types of Meters.

It will be seen that for similar flows the old types of meters caused a friction loss of 3 to 48 lbs. which of course is a serious detriment to fire protection. Furthermore, the Disc, Rotary Piston and Reciprocating Piston types are subject to clogging by sticks and sediment, and if wedged in place may prevent the passage of nearly all water through them. Practically all these meters, except the Venturi type, require strainers and fish traps. Dirt, leaves, etc., may become lodged in these strainers, especially in case of heavy draught, and seriously interfere with the flow of water. As the Venturi meter is not accurate for small flows and needs careful supervision it is quite evident that all of these types of meters are unsuitable for fire service pipes.

Methods of Overcoming Objections.

A number of methods of overcoming these objections have been suggested and tried, the more important being as follows:—

(1) Installing a meter of larger size than the pipe, such as an 8-inch meter in a 6-inch pipe. This would greatly reduce the friction loss but would not entirely do away with the possibility of sticking or clogging.

(2) Installing several meters in parallel. For example, a 6-inch pipe could be divided into five 3-inch pipes each containing a 3-inch meter, these pipes running together again into a 6-inch pipe. This would cut down the friction loss to a satisfactory point and would also have the advantage that in case one meter was clogged the others would probably be in good order. It is, however, an expensive arrangement.

(3) Proportional meter. In its simplest form this consists of a metered by-pass around a check valve or other slight resistance. Part of the water goes through the meter and yet leaves a free passage through the check valve. The meter in the by-pass can be made to read proportionally; that is, to show the total amount of water flowing through the main pipe and by-pass. In its older forms this was not a very accurate device.

Detector Meters.

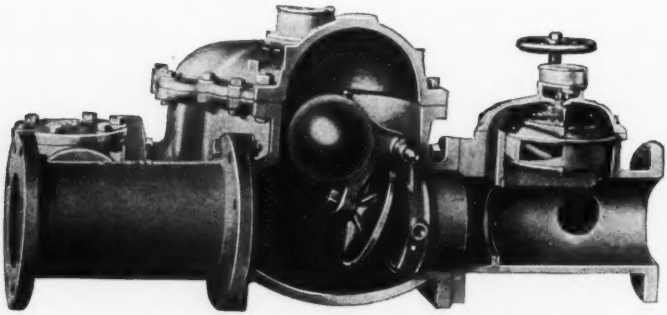
The failure of these devices to give the results desired led to the invention of the so-called detector meters. The first of these known as the Hersey Detector Meter type, D. M., consisted of a by-pass containing an ordinary meter gate and check valve around a check valve with a grooved seat. The by-pass was about half the diameter of the main pipe. There was a small pipe leading from the groove in the seat of the check valve to the atmosphere. This contained a small meter arranged to register time instead of quantities of water. This would register the length of time that the check valve was open and water was flowing.

The first experimental meters of this type gave trouble, owing to the fact that after the main check valve once opened it did not readily reseat. While it was on its seat there was a differential action due to the groove in

the seat, and this would hold the check closed until the pressure had been reduced about 6%. When the check opened the differential was destroyed, and as no excess pressure could be built up above the check, owing to the open by-pass, the check tended to remain "floating" instead of seating tightly.

This trouble was remedied by weighting the check valve with a hollow metal cylinder weighing about 20 lbs.

The Factory Mutual Insurance Companies also worked out a type of detector meter quite different from the above. It consisted briefly of a check valve with a by-pass arranged to accurately meter all the water, whether it passed through the by-pass or the main pipe. This was accomplished by having a meter in the by-pass arranged to register in two different ways.



HERSEY DETECTOR METER—F. M. Type

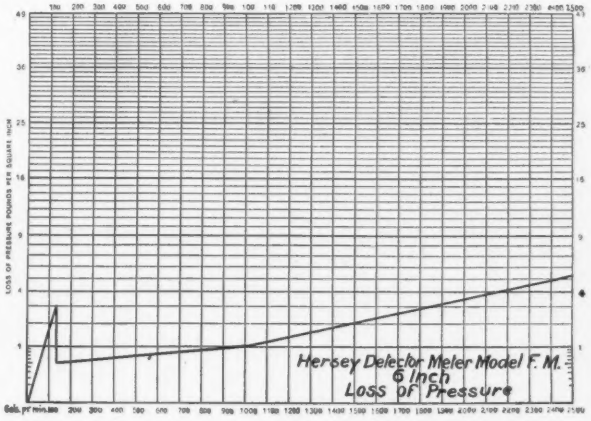
(Main pipe in section. By-pass containing meter at rear)

Before the main check opened the meter was acted upon directly by the water flowing through the by-pass. When, however, the check opened, owing to increase in draught, a lever was made to operate a mechanism that changed the registration of the meter and it then became a proportional meter and registered proportionally the amount of water that passed through the main pipe.

The Hersey Manfg. Co., of Boston, has lately developed this meter, and it is now built as shown in the cut, and is known as the F. M. type. There is one meter in the by-pass and an entirely separate meter in the main pipe in front of a baffle plate located close to the weighted check valve. This latter is a proportional meter and is permanently set to register the amount of water passing by the baffle plate by means of a certain proportion of this flow being deflected through the meter. Therefore, in order to find the total flow the reading of the meter in the by-pass is taken and added to the reading of the proportional meter in the main pipe.

This meter has now been developed so that it is not only accurate within 5% for all flows, but it also has a low friction loss. In a 6-inch meter, with 1,000 gallons flowing, the loss is about 1 lb.

The following curves show the friction loss of 6-inch meters of this type, with different amounts of water flowing and also the accuracy under different flows. It will be noticed that there is a sudden break in the curves when the flow reaches about 140 gallons per minute. This is the point where the main check valve opens, and the sudden destruction of the differential reduces the friction loss over 2 lbs.



FRICTION LOSS CURVE

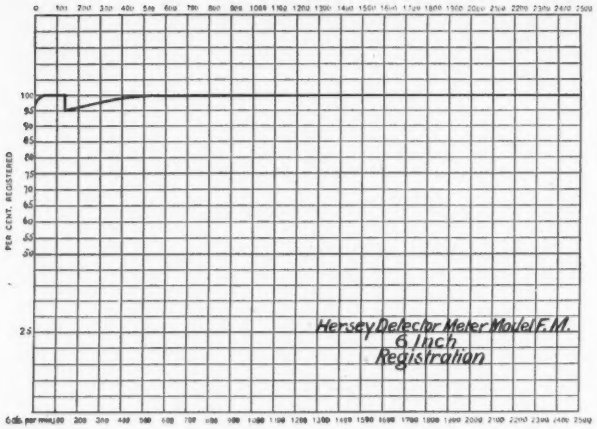
Horizontal spaces show gallons per minute.
Vertical spaces show loss of pressure.

This type of meter is now being almost universally used where meters are required in fire service pipes, and is looked upon with favor by both waterworks officials and the fire insurance interests.

It is, however, expensive and its use is not recommended except in cases where no other safeguard seems adequate.

Alarm Valves.

For sprinkler systems where the water works connections enter the building directly with no yard piping, the modern alarm valve should prove an ample safeguard against the loss of water. In its simplest form it consists of a swing check valve with a grooved seat. A small pipe connects with the groove in the seats and runs to the alarm mechanism, which usually



ACCURACY OF REGISTRATION
Horizontal spaces show gallons per minute.
Vertical spaces show percentage of water registered.

includes a diaphragm and circuit closer for an electric alarm and also a water motor alarm. No water can pass through the system without lifting the check valve and operating the alarm devices. There is, of course, a possibility that the alarm device may get out of order, but this is quite remote under the present rigid inspection system maintained by the insurance companies.

The insurance rules require that sprinkler pipes be used for fire protection purposes only, and practically all domestic service pipes are now either on separate pipes or connected below the main gate and alarm valves and metered.

Under the ordinary supervision from the water departments, therefore, the alarm valve should prove ample protection in all cases where the building protected is located on the street line with no underground piping on private property. In some cases, however, the water departments have required an additional safeguard either in the form of a half-inch meter or a recording gage connected to the grooved seat of the check valve. In case water is used and the check lifts, the meter will register either in time or quantity or the recording gage will be set in operation.

Another safeguard adopted in some cities is for the water department to seal closed all drip valves and hydrants and require that they be notified whenever these slabs are broken.

New England Cities Requiring Meters in Sprinkler Connections.

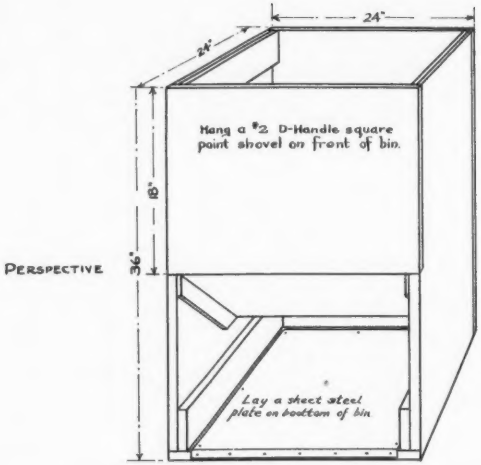
Massachusetts.	Rhode Island.	Connecticut.
Concord.	East Providence.	Ansonia.
Lowell.	Providence (high service).	Bridgeport.
Medford.	Woonsocket.	Jewett City.
Millers Falls.		New London.
Springfield.		Stamford.
Waltham.	New Hampshire.	
Watertown.	Nashua.	
Worcester.		

List of New England Cities Charging for Fire Service Connections.

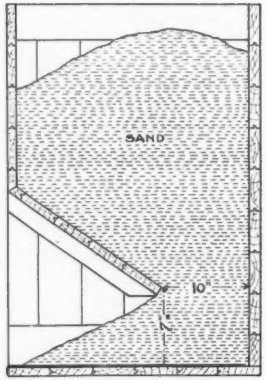
Biddeford & Saco, Me.	2″ pipe $30 per year. 3″ pipe $50. 4″ $80. 6″ $100. 8″ $150.
Portland, Me.	2″ pipe $30. 3″ $50. 4″ $80. 6″ $100. 8″ $150.
Claremont, N. H.	7½ cents per sprinkler. $20 to $30 per hydrant.
Bridgewater, Mass.	10 cents per sprinkler. $50 per hydrant.
Franklin, Mass.	$75 to $100 for sprinkler connection.
Gloucester, Mass.	$50 for sprinkler connection.
Hyde Park, Mass.	Formerly a charge. Now part of Boston.
Lawrence, Mass.	High service only. 4″ pipe $25 per year. 6″ pipe $50 per year.
Millbury, Mass.	15 cents per head per year.
Wakefield, Mass.	$35 per sprinkler connection.
Wellesley, Mass.	$10 per hydrant.
Westerly, R. I.	$25 per hydrant.
Ansonia, Conn.	$10 per first 100 heads. $5 per hundred for others. $28 per hydrant.
Bristol, Conn.	4″ pipe $30. 6″ $60. 8″ $120. $20 per hydrant or standpipe.
Manchester, Conn.	$30 per hydrant.
Rockville, Conn.	$75 to $100 for sprinklers.

Other Rules.

Boston, Mass. Nothing larger than four-inch connection allowed. If more than one is needed they must be 60 feet apart.



PERSPECTIVE



VERTICAL SECTION
SHOWING SAND CONTENTS

SUGGESTED SAND BIN

For fire protection where paints, oils, grease, light petroleum products or other similarly hazardous materials are used. Scale, ⅛" equals one inch. The drawing shows bin of ⅞" pine; #18 sheet steel may be substited. W.R.Kingsley, Engr 1912.

Sand as a Fire Extinguisher.

By W. R. Ruegnitz (Member N. F. P. A.)

It is the purpose of this article to suggest an improvement in equipment for using sand as a fire extinguisher.

For protection against fires in grease, varnish, paint, inflammable liquids, electrical machinery, calcium carbide and the like, where water lacks effect or even increases fire damage, common sand is valuable, and underwriters generally have required that **pails or barrels** of sand be provided, the latter to have "scoops" or "scoop shovels."

In fire protection a pail is well adapted to the keeping and use of water, but for sand it is adapted only to the keeping and not at all to the use. A 10 or 12-quart pail full of sand is heavy, generally lacking as to handles, and is therefore awkward to use. A barrel and shovel combination is much better, but by no means the handiest possible; you cannot dig into the top of a barrel and get out the shovelfuls of sand anywhere nearly so quickly, easily or conveniently as the exigency of the ordinary water-resisting fire demands. To demonstrate this, the best way is to take a barrel of sand and a shovel and start to dig—it might be of help to tip the barrel over so that the sand could be shoveled off the floor, but a full barrel of sand is heavy and not easily tipped. Quite possibly it may be placed or obstructed so that practically it cannot be overturned at all. Anything that makes for inconvenience assists the spread of fire, and of all fires the water-resisting fire least needs encouragement.

To eliminate these disadvantages of pails and barrels, the hopper-bottom bin is suggested. The accompanying illustration is perhaps sufficient description in itself. The size of shovel which will be most efficient in fire protection has not been determined by any special test, but the No. 2 D-handle square-point shovel is commonly used by contractors for handling fine sand and will give good service. The shovel should be fastened to bin by means of a light strap nailed on in such a manner that it can be pried off readily in case of fire, but may not conveniently be removed for other purposes. The bin should be painted white or whitewashed, so that it may be seen readily even though interiors are poorly lighted, and enough bins should be provided so that sand can be thrown directly from bin to fire. The words "For Fire Only" should be stenciled plainly on each bin.

The quantity of sand provided must depend upon conditions; the size of bin may of course be increased if need be. Locations of bins should be such that ready access and full knowledge by employees of their presence and purpose will be had at all times.

The Cost of a House.

A Comparison of Brick, Wood, Cement and Hollow Block Construction.

By J. Parker B. Fiske.

(From Report of the Committee on Fire Prevention of the Boston Chamber of Commerce.)

There can be little doubt, even in the mind of the casual observer, that brick is a very desirable material with which to build a house. The public has gradually come to realize the enormous loss by fire, the excessive repairs, the rapid depreciation and the discomfort in both summer and winter arising from frame construction, and to appreciate the fact that the house of brick is not only fireproof, but that it requires no painting, that it does not decay or depreciate, and that, of all types of construction, it is the most beautiful.

How is it, then, that America has continued so long to build her houses of wood, while the older countries of Europe abandoned this type of construction many generations ago?

An answer may be found in conversation with almost any intelligent man or woman—"The first cost of the brick house has been prohibitive."

However true this opinion may have been a generation ago, or however natural, to-day, to a people born and reared in a land of wooden houses, it no longer holds good.

Conditions have changed; wood is no longer cheap; our forests have receded from civilization and have dwindled in size until frame construction costs almost as much as brick—until, with its "up-keep," it costs more.

A great majority of the American people, however, who enjoy to the largest extent the benefits of human ingenuity and skill in other matters, are still denying themselves the advantages of a superior material for the construction of their homes because of a mistaken idea as to its relative cost.

It is time, therefore, that the present-day facts be made public in a clear and logical manner, that all may know the truth.

In order to prepare an accurate statement regarding the relative costs of different styles of construction, the writer has instituted a careful investigation, in which all variable quantities were eliminated and a bona fide bid obtained for the construction, in a given locality, of a series of houses, each one exactly like the others in every particular except the outer walls, which in the several houses were to be constructed of the

several materials we wish to compare; *i. e.*, brick, wood, cement and hollow block.

Lest a single contractor might make an error, or for some reason be unduly favorable to one material as against another, we have secured simultaneous bids from several equally reliable contractors. While the several figures on the brick house vary considerably among themselves, as is inevitable with competitive bids, the relative figures on brick, wood, etc., are about the same in the case of one contractor as of another, and the average gives a fair and truthful conclusion.

In making this investigation, a little modern eight-room house, of good design and excellent arrangement, was chosen, the original having been actually built near Boston.

This house is typical in size, arrangement and cost of thousands of houses which are being erected throughout the East.

The architects were commissioned to prepare the plans and specifications necessary for obtaining bids for this house when built with the following types of exterior wall construction, all other details being common to all types:—

Description of Various Types of Outer Wall Construction.

Type 1. Frame covered with boards and finished with clapboards over building paper; inside surface furred, lathed and plastered.

Type 2. Frame covered with boards and finished with shingles over building paper; inside surface furred, lathed and plastered.

Type 3. A 10-inch brick wall, *i. e.*, two 4-inch walls tied together with metal ties and separated by a 2-inch air space; inside surface plastered directly on the brick work. Face brick to cost $17.50 per thousand; inside brick, $9 per thousand.

Type 4. A 12-inch solid brick wall; inside surface furred, lathed and plastered. Face brick to cost $17.50 per thousand; inside brick, $9 per thousand.

Type 5. Eight-inch hollow terra cotta blocks, stuccoed on the outside and plastered directly on the inside.

Type 6. Six-inch hollow terra cotta blocks, finished with a 4-inch brick veneer on the outside and plastered directly on the inside. Face brick to cost $17.50 per thousand.

Type 7. Frame covered with boards and building paper, furred and covered with stucco on Clinton wire cloth; inside surface furred, lathed and plastered.

Type 8. Frame covered with boards (building paper omitted), and finished with a 4-inch brick veneer on the outside; inside surface furred, lathed and plastered. Face brick to cost $17.50 per thousand.

Type 9. Frame finished on the outside with a 4-inch brick veneer tied directly to the studding (boarding omitted); inside surface furred, lathed and plastered. Face brick to cost $17.50 per thousand.

A separate drawing showing the details of each type of outer wall construction was prepared, and each was accompanied by a set of complete specifications for the entire house.

Everything about the house, except the outer wall construction, was identical in all nine types, and may be briefly covered by the following table:—

Details Common to All Types.

A—Foundations.....Local stone.
B—Cellar floor.....Finished with 2-inch concrete of Portland cement.
C—Chimney.....Faced with brick costing $17.50 per M.
D—Fireplaces.....Faced with brick costing $17.50 per M.
E—Plastering.....First-class "two coat" work.
F—Exterior finish.....Cypress.
G—Blinds.....White pine.
H—Screens.....Copper bronze on white pine frames.
I—Window frames.....Hard pine.
J—Floors..Double floors throughout, with paper between, except in unfinished attic; Georgia pine upper floors; main hall on first floor of oak.
K—Inside finish.....North Carolina pine.
L—Doors.....Washington cedar.
M—Hardware..Bronze finish of ordinary type, costing $60.00 for the job.
O—Conductors.....Copper.
P—Flashing.....Tin.
Q—Electric Fixtures.....Costing $80.00.
R—Hot water heating.....Costing $250.00 complete.
S—Wiring.....Costing $68.00.
T—Plumbing.....Costing $370.00.
U—Painting.....Exterior and interior; clapboard house, $225.00; other houses, $130.00.
V—Glazing.....Double thick German glass.

NOTE.—Shades, kitchen range and tile work not included.

Five local contractors of well known reputation and experience were selected.

Each was fully advised of the object of this investigation, and was asked if he was willing to undertake the preparation of figures which should truthfully set forth, to the best of his ability, the costs (including his profit) of houses to be built within ten miles of Boston, according to these several plans and specifications. Each was told that we desired to know the exact truth; if, as alleged by some contractors, the cost of a brick house is twenty-five to thirty per cent more than one of wood, then we wished to know it, as nothing could be gained by an investigation of this kind which was biased or influenced by any favoritism for one type over another.

Each contractor entered into the spirit of the investigation heartily, and agreed to figure out the cost fairly, to the best of his ability.

Each contractor was given the same information and instructions, and each took plenty of time to figure the entire house with care.

The following are the bids submitted by the five contractors, each bidder standing ready to enter into a contract for the house in question at the figures submitted:—

COMPARATIVE BIDS

Type No.	1	2	3	4	5	6	7	8	9
Description	Clapboard	Shingle	10-inch Brick Wall Hollow	12-inch Brick Wall Solid	Stucco on Hollow Block	Brick Veneer on Hollow Block	Stucco on Frame	Brick Veneer on Boarding	Brick Veneer on Studding
Bid No. 1.....	$6,732.00	$.....	$7,572.00	$.....	$7,416.00	$7,777.00	$6,857.00	$7,130.00	$7,080.00
Bid No. 2.....	6,235.76	6,370.40	6,736.43	7,105.00	6,491.23	6,762.83	6,410.00	6,746.20	6,664.88
Bid No. 3.....	6,692.00	6,786.00	7,118.00	7,418.00	7,179.00	7,238.00	6,847.50	6,970.00	6,895.00
Bid No. 4.....	6,690.00	.....	7,496.00	7,801.00	7,202.00	7,648.00	7,000.00	7,496.00	7,420.00
Bid No. 5.....	7,450.00	7,450.00	7,940.00	8,240.00	7,650.00	7,990.00	7,650.00	7,790.00	7,710.00
Average of bids	6,759.95	6,868.80	7,372.48	7,641.00	7,187.65	7,483.16	6,952.90	7,226.44	7,153.98

COMPARATIVE BIDS

Percentage Excess Cost of Each Type Over Clapboards

Type No.	1	2	3	4	5	6	7	8	9
Description	Clapboard	Shingle	10-inch Brick Wall Hollow	12-inch Brick Wall Solid	Stucco on Hollow Block	Brick Veneer on Hollow Block	Stucco on Frame	Brick Veneer on Boarding	Brick Veneer on Studding
Bid No. 1.....	.0	....	12.5	....	10.2	15.5	1.9	5.9	5.2
Bid No. 2.....	.0	2.1	8.0	13.9	4.1	8.4	2.8	8.2	6.9
Bid No. 3.....	.0	1.4	6.4	10.8	7.3	8.2	2.3	4.2	3.0
Bid No. 4.....	.0	....	12.0	16.6	7.7	14.3	4.6	12.0	10.9
Bid No. 5.....	.0	.0	6.6	10.6	2.7	7.2	2.7	4.6	3.5
Average of bids	.0	1.6	9.1	13.0	6.3	10.7	2.9	6.9	5.8

In making up his figures, one contractor used the following:—

Price of Materials.

Lime	$1.00 per bbl., 200 lbs.
Portland cement	$1.60 per bbl.
Spruce framing	$26.00 per M. ft. B. M.
North Carolina pine	1c. per inch per ft.
Georgia matched pine (first quality)	$75.00 per M. ft. B. M.
Shingles	$4.75 per M.
Clapboards	$55.00 per M.
Hemlock boarding	$22.00 per M. ft. B. M.
6-inch hollow block	10 1-2c. per sq. ft.
8-inch hollow block	14c. per sq. ft.
Face brick	$17.50 per M.
Common brick	$9.00 per M.
Allowance for furring, Lathing, and plastering	5c. per sq. ft.
Wages of bricklayers	60c. per hour.
Wages of carpenters	50c. per hour.

Upon inquiry we have found much reliable evidence to corroborate our figures. We are permitted to refer to three investigations conducted by other parties in different parts of the country, as follows:—

Mr. William D. Austin, the well-known Boston architect, having made a careful investigation of comparative costs on a $10,000 house, makes the following statement:—

"The exterior walls are of brick, eight inches thick, with wooden furring strips against the inner surface, on which the lath and plaster are applied.

"The cost of this brickwork, including the necessary furring and the somewhat more expensive window frames and finish required would be about $1,200. The exterior walls, if in frame with shingles or clapboards, would cost about $600 less, and if in frame with metal lathing and cement plaster, about $500 less. In other words, if the total cost of the house in brick is $10,000, the saving in wood would be six per cent and in cement plaster five per cent.

"The figures here given are based on carefully-made estimates which were obtained from reliable contractors, and, generally speaking, represent the comparative cost of wood, stucco and brick walls."

Mr. Austin's figures are rather more favorable to the use of brick than are ours, which confirms the impartiality of our investigation and the conservatism of our conclusions.

Mr. W. E. Dunwody, of Macon, Ga., makes the following statement:—

"In January, 1910, I let a contract for a brick veneered house, in which I specified local face brick at $15 per thousand. I found from actual experience that a brick veneered house cost only about five per cent more than a corresponding frame house. Of course, the frame house could be cheapened by making the foundations lighter and by using an inferior grade of lumber, but that would make an inferior house and

would not be a fair comparison. The man who wishes to build as cheap a house as possible is not interested in this discussion."

Perhaps the most convincing verification of our figures is that contained in a letter from Hansberger & Livingstone, of Columbus, Ohio, who for fifteen years have been engaged in the building of moderate-sized detached houses for sale. They state as follows:—

"We have built about six hundred houses in the city of Columbus. The first year we built entirely of frame, the second year about half brick and half frame, and then we figured out the cost between the brick and the frame houses, and we found that the actual difference did not exceed $400 on a $5,000 house, or about eight per cent more for brick than for frame.

"We build most of our houses with a 9-inch wall and a one-inch air space, tying the two walls together with metal ties, and furring, lathing and plastering on the inside.

"Taking the saving in insurance, heating and painting on the brick house, we have found that there is really no difference in the cost of the houses at the end of a few years, and we now build brick houses almost altogether.

"When we come to sell the house, we find that we can always get about $1,000 more for the brick house than for the frame house, on account of the beauty, durability and economy, which always seems to speak for itself. The brick house looks so much more substantial than the frame house that we use brick every time.

"The brick house is much cooler in summer than the frame house, and we have tested the heating in winter and have found that it takes thirty-three and one-third per cent more fuel for a frame house than it does for one of brick."

Cost of Maintenance on Houses of Second and Third Class Construction.

An estimate of the probable yearly charge-off and repairs on a dwelling of third class construction, namely, all of wood, and on a dwelling of the same size, character of finish, etc., but of second class construction, namely, with exterior of incombustible material:—

1. Third class dwelling covering about 1,500 sq. ft., two and a half stories and cellar. Cost, $10,000. Estimated efficient life, 20 years.

Annual charge-off with interest at 4 per cent	$736
Repairs, painting, etc	250
Total per year	$986

2. Cost of house of same dimensions, but of second class construction, $11,500. Estimated efficient life, 40 years.

Annual charge-off with interest at 4 per cent	$580.75
Repairs and painting about	100.00
Total per year	$680.75

The cost per year on the above basis for a third class building is $305.25 more than that of a second class building, an increase of 45 per cent.

Applying the same reasoning to the ordinary three tenement house, of which so many are built in our suburbs, the comparison would be as follows:—

1. Three tenement house entirely of wood or third class construction, approximate cost, $6,500. Estimated efficient life, 20 years.

Annual charge-off with interest at 4 per cent	$478.40
Repairs and painting	150.00
Total per year	$628.40

2. Cost of house of same dimensions, but of second class construction, $7,500. Estimated efficient life, 30 years.

Annual charge-off with interest at 4 per cent	$423.50
Repairs and painting	75.00
Total per year	$498.50

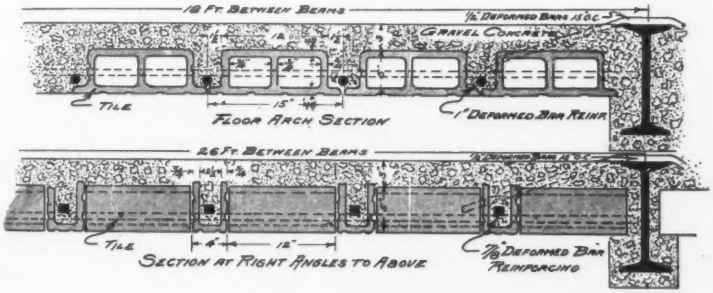
In this case the cost per year for the third class building is $129.90, or twenty-six per cent greater than that of the second class building.

Figures such as these can be only suggestive, and it would be almost impossible to establish anything like exact ratios of cost of maintenance, length of available life, or amount of depreciation, as these do not depend wholly on the nature of the construction, but are much modified by exposure, character of occupancy and by the frequency of change in tenants. But the figures are at least a justification of the conviction held by many experts, that, taking everything into account, a building of second class construction will wear better, last longer and usually cost less in the long run, than a similar building of third class construction, with combustible exterior. **The continued construction of wooden buildings would therefore seem to be a mistake from the standpoint of cost, of use as measured by length of life, and, above all, of the fire hazard.**

Building Collapse.

Late in the afternoon after a majority of the workmen had left the building, which was in course of construction, a section of the floor arches, 18 x 25 feet on all floors, collapsed, falling through to the basement and burying and killing in the debris four workmen.

The building was intended for a high-class fireproof apartment house, of area about 6,000 square feet. The construction was steel skeleton, with beams and girders of size and arrangement as shown in cut of steel framing. The columns (except a few angles) were Bethlehem rolled H section 8 inches, 31½ pounds at top story, and increasing in size to 12 inches, 105 pounds in basement.

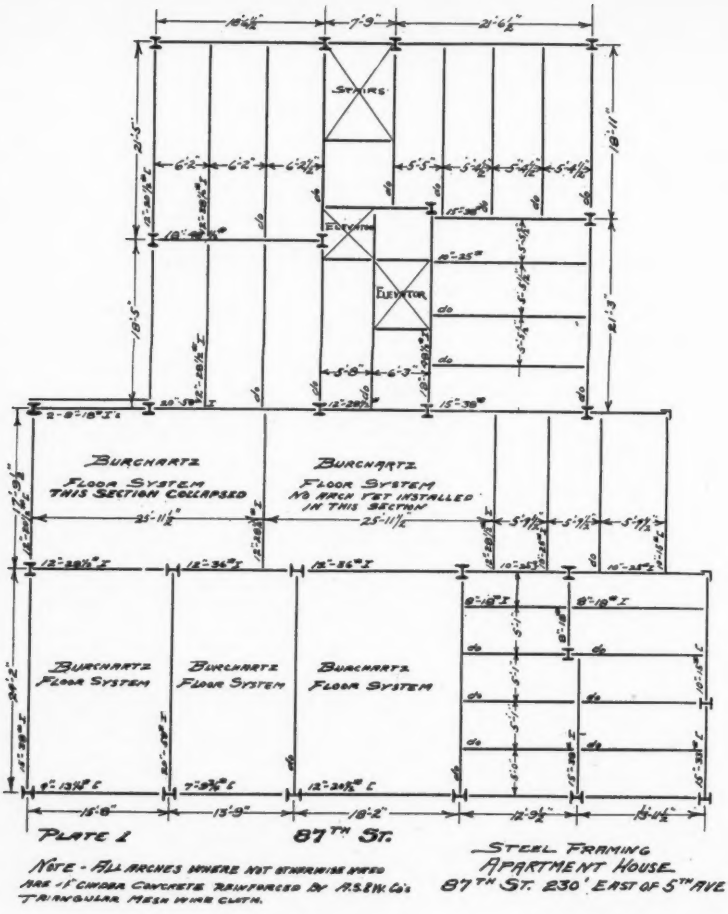


Typical Sections of Burchartz Long Span Floor Arches

Plate 2.

The floor arches in the rear of the building and the west section on 87th Street were of cinder concrete, 4 inches in thickness, of top haunch system, reinforced by American Steel and Wire Co.'s triangle mesh wire cloth. The centering for these arches was hung to the beams and girders by steel rods and the arches poured in the usual manner. At the time the collapse occurred the centering had all been removed and these arches were undisturbed.

Burchartz floor arches had been installed in four of the remaining panels, five in number. This system consisted of a 3-inch gravel concrete arch,



laid over and between 12x12x5-inch terra cotta blocks with two cells and ¾-inch webs, also a 1½-inch lip on two sides. (See cut). Between the blocks at the ends half of a split 4-inch terra cotta block was laid. Steel reinforcing was laid in the concrete in both directions. The floors were laid, starting at the bottom, shoring up the centering for each floor by studding resting on the floor arch below until the roof was reached.

The top tier (roof) had been poured on the day of the accident, the next below 48 hours previous, and the concrete in those beneath was only a few days old. The concrete in these floors not being set, they had

no inherent strength of their own, hence their weight was bearing on the floor arches below. It is possible that just before the accident the laborers had removed the centering from under the 2d floor, and this floor, overloaded by the weight of those above, collapsed, causing all the arches to fall through to the basement. It may be that poor quality of the concrete contributed to this failure. As there were no arches on the east and west sides of the failing panels, and the I beams had no tie rods, the springing of these beams may have contributed to the falling of the arches; in fact, in the lower floors, after the accident, these beams were bent out very noticeably. That the concrete had not set on the upper floors was evident from the manner it had fallen away from the I beams, leaving them bare, the shear rods were also standing out from the beams, whereas in the lower floors they were bent into a nearly vertical position before the cement lost its grip.

Features of the Burchartz Arch as Used in this Building.

As the terra cotta blocks used in this long span arch were on the under or tension side of the arch, it is apparent that they added nothing to its strength, their only functions being to fill the space between the concrete beams and form a smooth ceiling and to fireproof the concrete.

This left the floor arch consisting of a 3-inch slab strengthened by concrete beams, 3 inches wide and 4¼ inches deep in one direction and 2½ inches wide and 4¼ inches deep in the other direction, 15 inches on centers; reinforced ½ inch from the lower face by ⅞ and 1-inch rods.

This design figured out to be strong enough to carry the required load, but may be open to criticism in the following particulars:—

There should be on the sides and below the reinforcing rods a thickness of concrete equal to at least 1½ times the diameter of the rods, in order that the concrete may have a proper bond on the rods and avoid failure of the arch by the breaking and crumbling of the concrete about the reinforcing bars.

The ends of the reinforcing bars should be secured in a reliable manner to the steel I beams, or carried over the top and 40 diameters into the slab on the other side. After the collapse it could be plainly seen where the rods had pulled out of the concrete.

Tie rods should be used in these arches as well as others to prevent springing of the I beams.

Concrete Used on the Work.

The plans called for a 1-2-4 mixture of gravel concrete to be used on these arches. Whether these specifications were carried out is not known. Samples of concrete taken from the building after the collapse were very weak for a 1-2-4 mixture, though since that time they have hardened materially, showing that then the concrete was not fully set. These same samples, however, when soaked in water, softened materially and lost most of their strength, which indicated more or less dirt in the mixture.

Points Brought out by this Collapse.

While this collapse of floor arches, like most others, has pointed out the necessity of aggressive supervision over the selection and mixture of materials for concrete arches, it has particularly emphasized,—

1st. The undesirability of long span arches in general.

2d. The importance of designing only simple, rugged arches which may be readily constructed by ordinary labor with reasonable supervision.

3d. In constructing fireproof floors it is objectionable to use shoring supported from floor to floor on newly made arches; in any event, the supports should not be removed from any floor until all arches are thoroughly set.

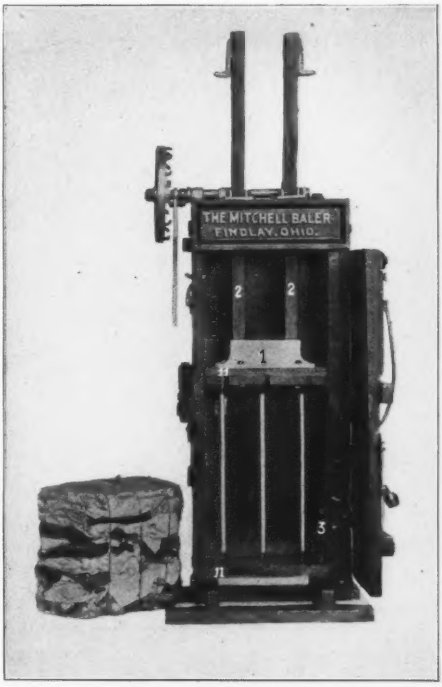
Turning Waste Paper Into Money.

One of the commonest hazards against which the vigilance of all the fire prevention forces requires to be constantly exerted is that of the accumulation of waste paper. It is singular that it is only within the last few years that the merchants of the country have awakened to the fact that waste paper may be a source of revenue. The principal difficulty has been that a safe and sufficient space for storage of waste paper could not economically be provided and it has seemed easier to burn or otherwise get rid of the paper every day than to allow it to accumulate until it could be advantageously sold. Modern ingenuity has, however, devised machines for baling paper regularly so that it may be conveniently and economically cared for until sold. Every ton of paper represents a value of from ten to twenty dollars. The accompanying illustration represents one of the most modern types of baler which not only makes a neat and compact bale but which is equipped with a register or counter which automatically records the number of bales passing through it. The operation of this device makes the bale by lifting up the plunger, which is held by an automatic latch; a large sheet of paper is placed on the bottom of the baler, the large door closed, the small door opened and the baler filled with paper. The plunger is then let down and pressed with the wheel. The baler must be filled several times to make a complete bale. A piece of smooth paper is placed on top for the last press, a catch on the wheel holding the pressure until the bale is wired through grooves, first through the bottom, then back through the top, and the ends of the wire are twisted together. After this operation the pressure can be released and the bale removed.

Description of accompanying illustrations. No. 1 is the iron plunger with two pistons which gives it great strength. No. 2 shows the pistons. If hard substances such as books get under one end of plunger and light paper under the other end there is no possibility of a strain or break, because of the two pistons. No. 3 is a swinging side that the counter is connected to, as shown in No. 8. No. 8 is box containing

counter which registers the number of the bale when the plunger is run down the first time. The plunger (No. 1) can be run up and down a number of times in making a bale but it records but once, but it is impossible to press a bale without the counter recording it. Nos. 11 are the grooves for wiring the bale.

Baler Closed Showing the Counter.



Baler Open Showing Plunger, Pistons, Etc.

MODERN WASTE PAPER BALER.

The Cooperage Industry.

By J. Albert Robinson

INTRODUCTION.

The art of the cooper is doubtless of great antiquity. Pliny ascribes the invention of casks to the people who lived at the foot of the Alps. In his time they lined them with pitch. Varro and Columella, previous to the time of Tiberius and Vespasian, at the beginning of the Christian era, in detailing the precepts of rural economy, speak distinctly of vessels formed of different pieces and bound together with circles of wood, or hoops. The description which they have given accords exactly with the construction of casks. In very early days in England the "good men of the mystery of coopers" had banded themselves into a Master Coopers Guild. Few people realize what a large business the manufacture of the ordinary barrel has become, and what an important part it plays in many other industries. The lowly barrel is one of the great necessities of commerce. The full process cooperage plants have now mostly past away from the east, especially those using hard wood, and are found in the timbered sections of the north and west.

Classes.

There are two distinct branches of the cooperage industry, one manufacturing "slack barrels" and the other "tight barrels." Although the processes and hazards are quite similar, the raw stock is quite different and both kinds of barrels are rarely manufactured at one plant. The "slack" barrel is so designated from the fact that it is only used to hold commodities which are not in liquid form. Flour and sugar barrels represent the highest grade manufactured. Cement, lime and salt barrels come next. Inferior grades are those barrels which are known as truck barrels, used for fruit and vegetables, and the barrels and kegs used in the crockery, glassware, and hardware trades. "Tight" barrels are those that are designed to hold liquid commodities; beer, wine and liquor barrels being the best type of this class. Pork, vinegar, paint and oil barrels are also common examples. The tight barrel plant, owing to the nature of its stock, is somewhat less hazardous than the slack barrel factory.

Many cooperage plants are not full process and the barrels are not made complete from the raw stock but merely assembled and finished, the raw stock, consisting of staves, heads and hoops, being made in factories

specializing in these products only. Some factories manufacture staves only, others headings only, while some manufacture staves and headings. There are some that manufacture staves in connection with a hoop mill. The manufacturing of hoops is quite a specialized industry, but may be found in many full process plants. This work was formerly largely done by individual hoop makers in a back shed on the farm, and in certain territories to-day large quantities of hand-shaved hoops are made by farmers or local coopers. Iron and steel bands and wires are rapidly coming into use, especially in the manufacture of slack barrels. Manufacturers of the latter have heretofore resisted this innovation, but probably in the future most slack barrels will be bound in part at least in this manner. Metal hoops have long been used in the manufacture of tight barrels. Many cooperage plants, especially where not full process, manufacture a side line of kegs, tubs, crate stock, trunk strips and dimension stock, such as chair rungs, posts, seat frames, etc.

Raw Material.

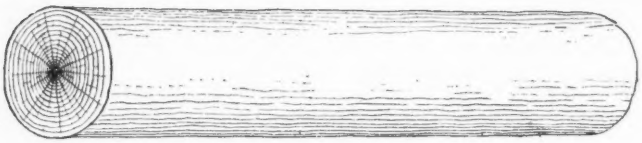
On account of its great strength and toughness, elm has long been the principal and favorite wood used for slack barrel staves and heads. Red gum is rapidly coming into favor and is undoubtedly destined to be the future wood used for this purpose. Oak is the most common wood employed in the manufacture of tight barrels. The principal wood used in the manufacture of hoops is elm; red gum, ash, hickory and birch are also used to some extent. The steel mills furnish an increasing amount of hoop bands and wires for this purpose.

Working Up the Raw Material.

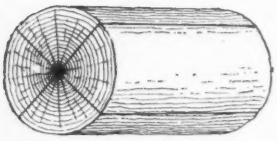
The Bolting Room is where the timber is sawed into the proper lengths for cutting into staves, heading or hoops. The logs are generally brought into this department from the log pond on an inclined log trough by means of an endless chain log jacker or log haul-up, and landed on the sorting deck where they can be properly inspected and put to the uses for which they are best adapted, the better grade of logs going into hoops or staves and the more inferior ones put aside for headings. Some mills use a steam kicker or a log unloader for throwing logs out of the log trough in the mill. The logs are then taken to the cut-off saw, which may be a "drag saw" or a "drop circular saw." "Steam dogs" are used for holding the logs firm and in position while being sawed, and may be of the overhead type or floor level type.

The blocks as they come from the drop or drag saw are then passed to the bolting saws where they are cut into short pieces or bolts, the proper length for the staves or headings. The bolts are then sawed into quarters, a process known as quartering, so as to allow keeping with the grain when cutting into staves. These quarters, or bolts, are further split into flitches, or stave bolts, a process known as bolting or flitching. The figures show these various conditions.

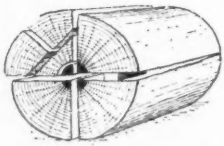
Preparing Sawed Staves and Headings.



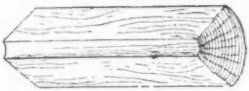
Shows the log as cut from tree.



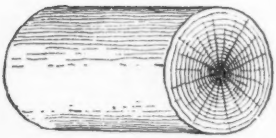
Shows manner of splitting timber into stave bolts where timber is of small diameter.



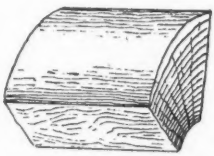
Shows manner of splitting section fortimber of large diameter into stave bolts. In making staves, as well as heading bolts, for oil and other tight work, it is ever and always necessary to keep with the grain of wood.



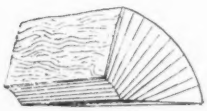
Bolt cut to uniform length on Bolt Equalizer ready for cylinder stave sawing machine.



Shows section of log as cut 3 feet long, for stave bolt.

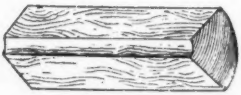


Shows heading prepared from tree same as in stave bolt.



Shows manner of sawing pieces of heading from Bolt by the Head Sawing Machine. They are cut 1 inch thick upon sap, ¾-inch thick at the heart, 24 inches long. Two or three pieces are required to form a complete head.

Shows manner of sawing staves upon a cylinder stave machine.



Stave bolt quartered and heart split off.

Steam Boxes for Stave Bolts. The principal object to be obtained in steaming the wood before cutting is to extract or force as much of the sap out of the timber as possible, at the same time making the fibres of the wood soft and pliable so that it will shear or cut easily and dry quickly after being cut, in order to lessen the possibilities of the staves moulding. For some woods a longer time, less heat, or lower pressure, and more moisture is advisable. A combination of live and exhaust steam is frequently used. There are different types of steam-boxes in use, and the tendency is, where new plants are constructed, to make them of concrete, which is no doubt the most satisfactory method from the operative point of view, and far to be preferred from the fire hazard point of view. Where steam-boxes are constructed of wood, it is often necessary to rebuild them as often as once every two or three years.

Making the Staves.

After the stave bolts have been properly steamed and barked, they are taken to the bolt equalizer, which cuts the bolts to proper lengths for staves. There are several methods of making staves. Knife cut staves are made by the steam-box and knife chopper. These staves are said to be satisfactory for barrels only when made from large fine elm timber which has been properly steamed, cut and jointed. Veneer staves are made by cutting sections of logs into stave lengths; boiling in vats of hot water; then passing through a rotary veneer lathe, which turns off a veneer about three-eighths inches thick, and a clipper cuts the staves from the sheet. This process is largely now impracticable by reason of the fact the timber suitable is too valuable for the purpose. Slat staves may be cut with single or multiple circular saws, and saw mill slabs can be utilized for the purpose. This process is little used, however. For manufacturing slack staves from soft woods, the cylinder or drum saw is being most generally adopted in this country to-day. Some tight barrel factories use regular quartered oak strips. At this point the staves may be air seasoned or put directly into dry kilns. This is described later.

Completing the Stave. The staves are planed to produce a finish and uniform thickness and are passed to the jointer. This is a rotary steel wheel, having hugh discs that travel at a high speed. The faces of the discs are provided with knives supported by caps, and their faces are turned to give the staves necessary bilge and bevel. The last operation consists of crozing, chamfering and equalizing, both ends at one operation, upon an automatic crozer, this completing the finished stave. This last operation may be omitted at this point and done in the cooper shop, after the barrels have been set up. Unless previously sufficiently dried the staves are then sent to the dry kilns. In factories which manufacture staves only, it is necessary to pack the staves into bundles subsequent to shipping, and for this purpose a stave press is used. In the use of this machine the staves are packed alternately, wide and narrow ones, and so arranged that each and every bundle will contain as nearly 200 inches as possible; this is figured

as fifty staves, averaging four inches per stave to each bundle, and is the standard method of packing.

Manufacturing Heads.

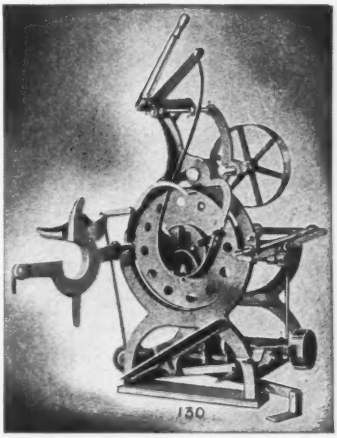
The process of "bolting out" or preparing heading bolts is accomplished in a manner similar to that of making staves. When the heading bolt has been properly prepared, it is taken to the heading saw. This may be of the upright or pendulous swing type, or the horizontal hand feed type. The heading blanks being thoroughly air-dried or kiln-dried, as the case may be, and then thoroughly acclimated, are brought to the heading room for finishing and turning. Here they pass through the heading planer and then the heading jointer, which may be either a wheel jointer or a saw jointer. After the heading pieces or blanks have been properly jointed, they are matched, or the pieces assembled for the size head to be turned. Care is taken, in matching up the head blanks, that the narrow pieces are placed in the center of the head and the wider ones on the "cant," as small, narrow cants are extremely difficult to hold in the bundle and also more or less difficult to put into the barrel. It is generally the rule to assemble these heading pieces in piles up to a convenient height on a bench or short skid, and as the operator on the heading turner finishes one pile, the next one is shoved up to within easy reach.

The heading turners are designed for circling all sizes of heading or square-edge covers, and are almost automatic in their operation. Aside from placing the heading blanks in between the clamps, all that is required of the operator is to tread upon a foot lever, and by this one operation the heading pieces are clamped, then immediately brought in contact with the saw and the machine put in motion. When the head has been turned, the machine throws itself out of gear, discharges the finished head, and is in position to receive another. The operator, having no need to touch the machine with his hands, can have the next head ready to drop into the machine the moment the finished one has been discharged. The heading turners are also equipped with a chamfering saw which turns the outside bevel on the head. This is a very important feature, for if the bevel on slack heading is too sharp and put into the package "stiff" it has a tendency to cut into and weaken the chime; and if the bevel be made too blunt, it does not enter the croze properly, and the head is liable to fall out, should the package receive a sharp, sudden jolt. After the heading has been properly turned, it is packed in bundles and bound with wire or flat steel bands, in a heading packer if the complete barrel is not made on the premises.

The Manufacture of Slack Barrel Hoops.

There are two distinct methods of manufacturing coiled hoops,—cutting and sawing. In the former method, the timber is sawed into planks at the sawmill, of a thickness that will make the width of a hoop, then cross-cut to proper length, after which it is put into a boiling vat and when

the wood fibres are properly softened by the hot water the planks are taken to the hoop cutter and sliced by a large knife into thin strips or hoops, and then jointed and lapped. Where sawed hoops are made, the timber is also sawed into planks at the sawmill, but instead of being boiled and cut with a knife, the plank is run through a gang ripsaw, which saws it into bars that are of sufficient thickness or size to split and make two hoops. It requires more timber to make a given amount of sawed hoops than it does to make the same number of cut hoops, because a certain amount of the wood is wasted in sawdust.



The Hoop Coiler.

A cut hoop plant generally has a hoop cutter—that is, a long heavy knife that cuts the hoop from the plank—a jointer or lapper, a hoop planer, and a coiler. For sawed hoops one generally requires a sawing outfit, which consists of a machine that contains both a planer and a jointer or lapper, a self-feeding rip or gang saw for preparing the bars or strips, and a coiler. The hoop-coiling machine turns out from 16,000 to 20,000 hoops per day. Hoops must be placed in the coils while they are hot, otherwise the fibres of the wood are strained or entirely broken. It is necessary to pile hoops in yards so that they may become properly seasoned. When properly seasoned, they should be taken in and placed under cover or shipped.

Dipping. The introduction of metal hoops has brought a new hazard into the cooperage industry—that of dipping. A cheap coating liquid is used, which is applied to prevent rusting. It consists principally of benzine with rosin in solution. As these dipping tanks are found in use by those who have not been educated to the use of this hazardous process, the arrangements are apt to be about as bad as possible, and this feature should be carefully looked into by inspectors and engineers in the future. Standard dip tanks and approved arrangements should be insisted upon.

Handling and Disposal of Waste.

The principal hazards of the processes previously described consist in the handling and disposal of the waste. The total percentage of ultimate waste in manufacturing cooperage stock, even in the best regulated mills, is astonishing. Studies made by the Forestry Service of the United States Department of Agriculture indicate that in the manufacture of staves and hoops, only fifty to sixty per cent of the contents of the log which goes

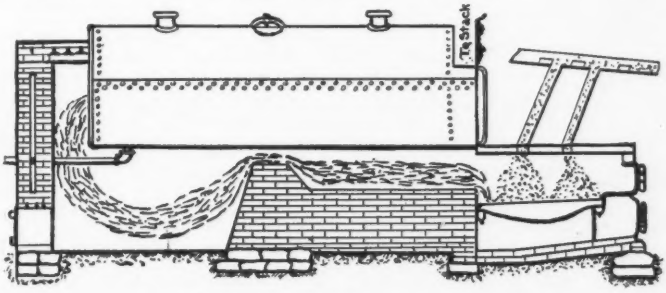
into the mill finally emerge in the manufactured form, and that with heading perhaps no more than twenty-five to thirty per cent of the actual volume of the log finally goes into the finished package. The disposal of this waste is, therefore, a serious and important item.

Conveying. Three methods are in vogue, with numerous variations. These are, first, hand removal, in which shavings and dust are discharged into the open room, swept up by hand and taken to boiler room in wheelbarrows or trucks; second, by chain or belt conveyor discharging to fire pit; third, the well known fan blower system with cyclone separator, which is the method in general use and the only approved method. An effective system requires that all the machines should be connected with it; that the main pipes should be as straight and smooth as possible, without obstructions, which both produce back pressure on the fan and collect dust that the fan should be as compact as possible in its construction, with both bearings outside and self-oiling; and that there should be efficient cyclone regulation. With a one-story woodworking building, the best location for the fan is the basement. It should have an "up discharge" to the roof, over which the main discharge trunk may be run to the shavings vault. The cyclones should be located on the roof of the shavings vault and provided with a screen at the top to prevent sparks from chimneys or exposure dropping into the vault. Automatic cut-offs or dampers in the discharge pipe between the cyclone and fan are not considered generally advisable, as they are unreliable and form an obstruction in the pipe. The fan should always be run for five minutes after the machine room shuts down, to clear the system of dust, in which case there is small liability of a vault fire backing up through the cyclone and discharge pipe and thus getting into the mill.

Storage. The shavings and waste are either fed to boiler direct or sent to shavings vault. These should be constructed and located according to well recognized standards, and protected by properly installed automatic sprinklers and steam jets. Many fires originate in the shavings vaults of cooperage factories. With few exceptions, boiler furnaces are directly or indirectly responsible for these fires. Of causes not originating at boiler furnace or stack, the following may be noted: Sparks from exposure entering unscreened top of cyclone; oily waste or sawdust being blown through fan to vault and igniting spontaneously; spark originating in the fan from some metallic or hard substance striking the blades; or from long shavings winding about fan shaft and heating from excessive friction, the resulting fire or spark being blown to vault. It is also possible that a fire or spark originating at one of the woodworking machines, particularly a sander, may be blown through the fan to shavings vault. When the construction, arrangement and protection of shavings vaults are in accordance with the best known rules, a vault fire ought not, and probably would not, cause serious damage.

Disposal. The waste and refuse is burned under the boilers, and may be fed into the furnace by hand, or may be drawn in through metal

pipes direct from the cyclone. The latter method is the safest and gives better all round results with the ordinary type of boiler furnace. Among the common causes of fire in the boiler room due to the inherent hazard in the combustion of light materials, are so-called "back drafts" (really smoke vapor and gas explosions inside the furnace) which throw sparks or coals from the furnace into shavings piles and vaults; or in case of poorly arranged furnace feed pipe, the fire may be carried back through this pipe into the shavings vault, or even into the main plant. This danger is eliminated and the disposal, utilization and combustion of large quantities of bulky, light, heat-giving fuel greatly facilitated by the use of the so-called Dutch oven, or bulldog furnace.



DUTCH-OVEN.

Dutch Oven. This is simply an extension built in front of the boiler into which the fire grates are placed instead of being put inside of the boiler wall proper, and underneath the front end of the boiler. The details of construction differ, but the general idea is the same in all cases. These ovens are generally built about ten feet long and should be fully as wide, and can very well be wider than the boiler front itself. All kinds of culls, sawdust, bark, etc., can be thrown into them without much effort, making them a labor saver and the most economical furnace for this purpose. The illustration shows the sawdust being conveyed direct to the furnace through the blow pipe, and can be dropped in equally as well with a chain conveyor. There should be an extra large opening on top to allow the fireman to shovel or scrape the creeping fires into the furnace from the floor level. The blow pipe, or chain conveyor, should be arranged in such a manner, having an extra leg or side extension with a switch or damper attached, so that when no fuel is wanted directly under the boiler, it can be thrown to one side. Under such conditions the fuel should not be piled on top of the oven, as fuel frequently ignites here. It is needless to say that platforms of wood, built up to the level of the oven floor, should be protected. This furnace frequently has a rather hazardous appearance and is carelessly operated, yet does not appear to have caused many fires. In fact, such furnaces materially reduce the hazards of waste disposal.

Elm Barrel Hoops Piled for Seasoning.—Arkansas.

Seasoning and Drying.

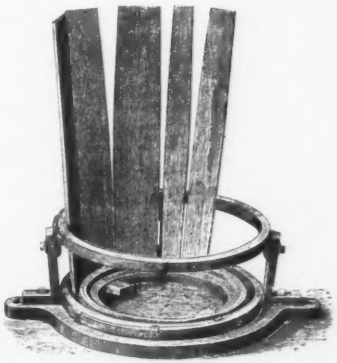
Seasoning is ordinarily understood to mean drying. When exposed to the sun and air, the water in green wood rapidly evaporates. Seasoning also implies other desirable changes in the wood besides the evaporation of water, the nature of which is not understood. The most effective seasoning is without doubt that obtained by the uniform, slow drying which takes place in properly constructed piles outdoors, under exposure to the winds and the sun and under cover from the rain and snow, and is what is termed "air-seasoning." By air-seasoning oak and similar hard woods, nature performs certain functions that cannot be duplicated by any artificial means. Because of this, woods of this class cannot be successfully kiln-dried green from the saw. Slack barrel staves and heading dry faster than tight barrel stock, from the fact that they are much thinner. Air-drying out of doors takes from two months to a year. After this preliminary seasoning, the heads and staves are kiln-dried. With soft woods it is common practice to kiln dry direct from the saw or knife, but many manufacturers prefer to pile the staves in the yard or under open sheds to season. Open sheds are now considered by the progressive manufacturers as being the most economical

and proper method of piling staves for proper seasoning. The sheds are usually about 20 feet wide and 100 to 150 feet long. The seasoning sheds often form serious exposures to the main plant, and where a plant is located near a railroad, fires in these sheds are not infrequent, due generally to locomotive sparks. Sheds should be located an ample distance from principal building to prevent forming serious exposures.

Dry Kilns. No special form of dry kiln has developed in the cooperage factory. The usual types may be found. As many plants are old and long established, few are equipped with very modern installations, and serious fires in dry kilns are fairly frequent and generally very disastrous. Dry kilns should preferably be detached from all other buildings and built in the most approved manner. Above all, wood sheathing and hollow wood finish should be removed where present, and if area is large, kiln should be divided into sections by fire walls. Dry kilns should be completely sprinklered and provided with steam jets. A few manufacturers have arranged carbonic acid gas generators, so that gas may be immediately generated and turned into the kiln in case of fire. Kilns should be so constructed that cleaning out wood dust is an easy matter, and pipes should be so located that all stock can be kept clear of same. Any connecting hot air or blower pipes between dry kilns should be arranged with dampers or other positive cut-offs. In case of fire, all blowers that may be running should be stopped, and all dampers in kiln flues closed. All kiln doors should be tightly closed.

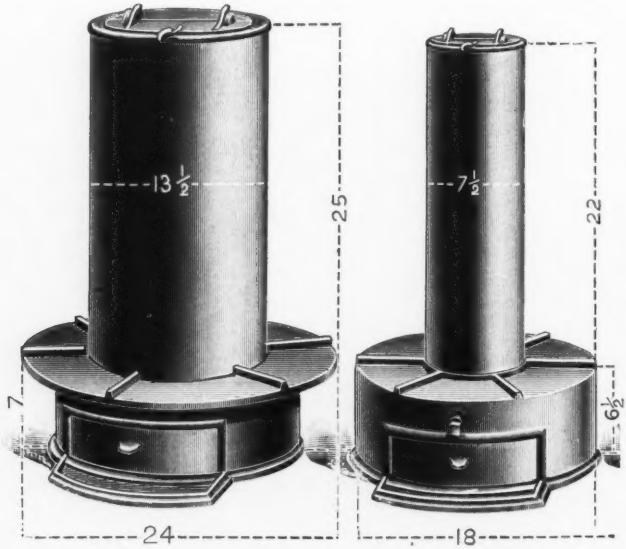
Coopering.

If the plant is full process, the staves after they come out of the kilns are sorted out into bundles containing the suitable number to complete a barrel, and sent to the cooper shop. If the staves are received from another plant the bundles, which have been previously made, are first put into kilns and redried before going to the cooper shop. In many tight barrel shops the staves are air dried only. The first process is assembling or "setting up." A "setting up form" is used by the cooper to set up the staves into barrels. The standards on which the quarter hoops rest are adjustable for different sizes of barrels, but the bottom iron ring around which the staves are set has to be of a different diameter for varying sizes of barrels. The upper ring is called a truss hoop. The set up barrel is then taken to a power windlass, where a wire rope loop is dropped over the top of barrel and the staves drawn together and held a moment while the oper-



Setting Up Form.

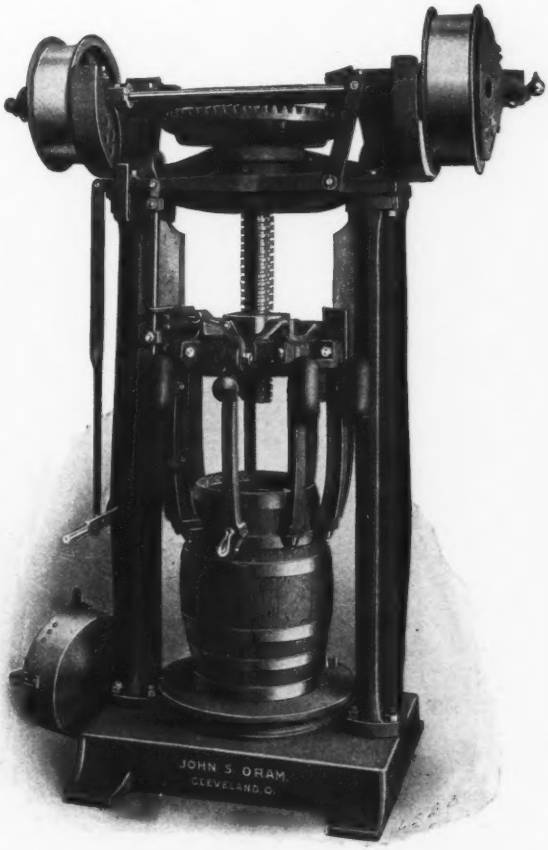
ator drops on a head truss hoop over the end. A clutch loosens the rope by depressing a foot lever, and the rope is drawn out of the way by a weight. The power windlass is not necessary for all types of barrels.



Barrel and Keg Heaters.

It is very essential that the staves be absolutely dry before applying the hoops, in order that the staves shall hold their position and not spread while being headed. The assembled barrel is thereafter put on a barrel heater or criset, and scorched. The accompanying cut shows the simplest form of criset. The fire box is at the base and wood or coal may be used. The heaters are made with an inside corrugated fire-holder, and an outside sheet-iron casing. The headless barrels are set over the crisets for a few minutes to heat sufficiently. Frequently the inside of a barrel takes fire, whereupon a workman takes it up and blows out the fire. Sparks are sometimes blown into other combustible material and a fire ensues. These crisets are generally located in a large brick oven hearth or fireplace, the chimney from which produces the required draft in the criset. There are some forms of patented barrel heaters now in use that are far to be preferred. These consist of heaters elevated above the floor with an automatic lifting arrangement, on which the barrel may be placed on the floor and elevated to the inside of heaters, which are supplied with gas burners. A battery of these heaters may have ventilating pipes connecting with a single trunk line, through which a draft may be secured and the sparks, if any,

carried off. In tight barrel factories it is necessary to steam the assembled barrel before it is heated, in order to soften the hard wood.



Beer, Keg and Barrel Hooper.

The barrels then pass to a machine which automatically joins the trusses on more firmly, thus making the barrel tight and ready for the hoops. If the staves have not been previously chamfered and crozed, this is now done, after which the quarter trusses are removed and the hoops placed around the barrel, put on a machine and pressed into place. The barrel is then automatically headed at one end and the end hoops placed in position. Some barrels are sandpapered on belt sanding machines before the hoops

are in place. In manufacturing some barrels the heads are glued. Electric heated glue-pots are coming into quite general use for this purpose. Many barrels are sized inside, especially tight barrels. This is generally accomplished by using melted paraffine, which is melted in steam jacketed kettles. Hand coopered barrels are considered the best and most of the large tight barrels, especially those used in the liquor and spirit industries, are so made. Beer barrels and kegs and similar small goods are generally machine coopered. The refuse which accumulates in the coopering room is generally removed by hand.

Saws and Knives.

Saws do not run or fit themselves, and they require the proper amount of care and attention in order that they may produce a maximum quantity and improved quality of output on a minimum saw kerf. The most successful coopers to-day consider it good practice and a profitable investment to supply every tool or appliance calculated to facilitate the filer's work. Knives also need much attention. They are sharpened either by hand file, grindstone or emery wheel. Knives are sometimes tempered at the cooper shop. There is nothing in the filing room equipment that offers any hazard.

Storage.

The storage of large quantities of bundled staves and finished barrels offers an opportunity for stubborn fires and large losses, owing to the large amount of piled inflammable material and obstructions to distribution of water where sprinklers are present. A large salvage may result from staves which have been wet down, as they may be dried in the kilns and used. Where the barrels are wet, they are apt to swell and burst the hoops, thus entailing a considerably greater loss.

Department of Fire Record

J. ALBERT ROBINSON, Superintendent.

The Cooperage Factory Fire Record

In nearly every fire contained in this record a finished barrel was the final product of manufacture. In many cases staves and heads were probably not made at the plant and probably in very few cases were hoops made at the plant. The data was insufficient to make a satisfactory classification of this kind. It would also have been desirable to distinguish between the fires occurring in plants manufacturing slack barrels and tight barrels. These terms are explained and the characteristic features of the cooperage industry described in a special article covering this subject on page 470.

The greatest number of fires was due to common causes, these amounting to thirty-seven per cent of all fires, nearly half of which were attributed to boilers. Dry kilns were the most potent special hazard cause of fire.

About one-half of the common cause fires resulted in no claim for insurance indemnity, and forty-three per cent of the special hazard fires had the same result. Seventy-three per cent of the common cause fires, where the sprinklers operated, resulted in no claim for insurance indemnity, while sixty-seven per cent of such fires in unsprinklered properties resulted in a large loss. Sixty-five per cent of the special hazard fires, where the sprinklers operated, resulted in no claim for insurance indemnity, while seventy-five per cent of such fires in unsprinklered properties resulted in a large loss.

In every fire attributed to presence of boilers in sprinklered plants, no claim resulted. Of the seven fires which occurred in unsprinklered plants from this cause, four resulted in large loss, two in small loss, and in only one case was there no claim. In every dry kiln fire in unsprinklered kilns the resulting loss was large. Of the seven fires which occurred in sprinklered dry kilns, four resulted in small loss, two in a large loss, and in one case no claim for insurance indemnity was made.

Over eighty-six per cent of all fires which occurred in plants equipped with sprinklers occurred in plants equipped with a dry system. No case of sprinkler failure was reported as due to this fact, and the general sprinkler record is good. This is a good testimonial of the practical results which may be expected from classes which are generally equipped with dry systems. Approximately fifty-seven per cent of all fires were practically or

entirely extinguished, thirty-two per cent held in check and in twelve per cent of the cases the work of the sprinkler equipment was unsatisfactory.

The average pressure in those cases where the fires were practically extinguished was about eighty pounds; in those held in check sixty-six pounds; and forty-eight pounds in the unsatisfactory cases. In the cases where no claim for insurance indemnity resulted, the average pressure was seventy-seven pounds; in those where the loss was small seventy-one pounds, and forty-three pounds where the loss was large.

An average of 6.3 heads opened in all cases, excluding the fires where the work of the sprinklers was unsatisfactory. In the cases where the fires were extinguished, an average of 5.3 heads opened, and an average of 7.8 heads opened in the cases where fire was held in check. In the cases where no claim for insurance indemnity resulted, the average number of heads which opened was 4.7; where a small loss resulted, the average was 8.4; and where a large loss resulted the average was 41 heads per fire.

Of all the fires which occurred in sprinklered plants, 63.5 per cent resulted in no claim for insurance indemnity, while in 9.5 per cent of the cases a large loss resulted. On the other hand, in the unsprinklered plants only two per cent of the fires resulted in no claim for insurance indemnity and a large loss resulted in 73 per cent of the fires. In those cases where the sprinklers practically or entirely extinguished fire, ninety-four per cent resulted in no claim and six per cent resulted in a small loss only. In those cases where the work of the sprinklers held fire in check, only five per cent of the fires resulted in a large loss, and fifty-three per cent resulted in a small loss. In those cases where the work of the sprinklers was unsatisfactory, seventy-one per cent resulted in a large loss, and a small loss occurred in the remainder. Only six per cent of all fires occurring in sprinklered plants resulted in a large loss and in forty per cent of the cases, no claim was made for insurance indemnity.

Secondary water supplies did not play an important part in these fires. In twenty per cent of the cases the secondary supplies were called upon, but in forty-two per cent of these cases the work of the sprinklers was a failure, and in a similar number of cases a large loss resulted. An average of seventy-eight heads were opened in each case. The primary supply was a pressure tank in fifty per cent of the cases and an automatic pump in twenty-five per cent of the cases.

Cooperage Factories—Fire Record

Total Number of Fires, 111.

1. CLASSIFICATION OF CAUSES.

Summary.

Common Causes.

	No. of Fires.	Per Cent of Common.	Per Cent of Whole.
Lighting	2	5	1.8
Power	3	7	2.7
Spontaneous Ignition	2	5	1.8
Boiler	19	46	17.2
Sparks (Source Unknown)	2	5	1.8
Smoking	3	7	2.7
Locomotive Sparks	8	20	7.2
Rubbish	2	5	1.8
Total	41	100	37

Special Hazards Causes.

	No. of Fires.	Per Cent of Special.	Per Cent of Whole.
Dry Kilns	16	46	14.4
Shavings Vaults	13	37	11.7
Barrel Drying and Crisets	6	17	5.4
Total	35	100	31.5

Common Causes	41	37.0
Special Hazard Causes	35	31.5
Exposure	3	2.7
Incendiary	5	4.5
Unknown	27	24.3
Total	111	100.0

Details.

Common Hazards.

Lighting 2
- Defective electric light wiring.
- Workman entered oil room with a lighted torch and filled a can of crude oil from barrel. Oil was ignited by the torch.

Power 3
- Supposed to have been caused by hot journal.
- Fire originated around a shaft bearing which was set in wall between boiler and engine rooms.
- Loose pulley revolved against joist, causing friction.

Spontaneous Ignition 2
- Details not reported.

Boiler 19
- Sparks from boiler 6
- Sparks from furnace while starting fire under boilers.
- Fuel pile ignited by fire from furnace.
- Spark from furnace lodged in dust in crevice of a wood partition.
- Sparks ignited shavings in wooden chute from room above.
- Spark started fire in shavings which were in room with boiler and fed by hand.
- Fire originated over breeching and between joists.
- Sparks ignited shavings in front of boilers.
- Sparks ignited dust on top of boiler.
- Boiler ignited sawdust.
- Furnace ignited shavings and dust in engine room.
- Sparks from boiler ignited fuel in fuel room.
- Refuse used for fuel ignited by furnace fire.
- Ignition of combustible material on or near boiler uptake.

Sparks 2
- Sparks from outside entered through open door in monitor.
- Sparks from outside.

Smoking 3
- No details 2
- Cigar or possibly match dropped through a hole in sidewalk and set fire to fuel.

Locomotive Sparks 8
- Sparks fell on dirty roof of dry kiln.
- Sparks ignited old shed.
- Sparks from locomotive—no details 4
- Sparks from locomotive passed through skylight.
- Sparks from locomotive fell on shingle roof.

Rubbish 2

Factory located on an old dump ground filling, which had been smouldering for years. A new supply of lumber was piled on the grounds and ignited by the smouldering rubbish.

Fire orginated by rubbish in engine room.

Special Hazards.

Dry Kilns....16

Fire originated in stave kiln, eighteen by eighty, and sixteen feet high; brick walls and brick arched roof with joist ceiling five feet below; cement floor.

Fire caused by bits of tarred rope yarn, splinters, etc., which collected in space below slatted floor and became overheated.

Fire in kiln; thought to have originated from spontaneous ignition.

Fire originated in frame dry kiln.

No details....4

Fire originated in frame dry kiln, sheathed inside with tar paper between and covered on outside with corrugated iron; heated by live steam direct from boilers. Steam pipes were so arranged and construction was such as to make it difficult to clean out the wood dust.

Fire originated in a wooden kiln of crude construction with brick flues.

Fire originated in dry kiln but exact cause is not known....2

Fire originated in fan room of dry kiln.

Fire originated in drying room of dry kiln, which was heated by hot air system with coils and blower enclosed in metal.

Probably smoking or matches in dry kiln.

Dry kiln had been cold and when steam was turned on and kiln became warm, fire was discovered. Thought to have been caused by a match in the debris.

Shaving Vaults....13

Sparks from stack ignited wooden structure around dust collector on roof of shaving vault.

Sparks from boiler entered shaving vault....6

No details....4

Sparks drawn into cyclone and blown into shaving vault.

Fire originated in separator in shavings conveyor system from boiler spark which fed back from pipe into separator.

Crisets and Barrel Heaters....6

Spark from barrel heater lodged under platform used for joining the barrels after heating.

Spark from criset set fire to pile of shavings and blocks.

Fire caused by spark in barrel after having been passed from barrel heater to barrel opener.

Started around criset.

Live coals left in barrel heater over night.

Barrel removed from barrel heater while still burning or emitting sparks, and spark found lodgment in lightly constructed barrel loft above.

Exposure.

A 350,000 gallon gasolene tank, which contained 100,000 gallons and was located 200 feet away, suddenly exploded. Burning oil was sent into the air and a heavy wind blew flames into buildings.

A smoke fire to drive Buffalo gnats from cattle was blown to a sawdust pile, thence to an old office building. The shingles from the latter were blown about 300 yards and they set fire to this factory.

Fire caused by burning of exposing hay warehouse and stable.

Incendiary.

Originated in dry kiln and employee was discovered coming away from kiln at same time fire was discovered, and he was discharged.

When discovered fire was burning in two widely distant portions of the plant.

No details.

Unknown.

Started in pile of finished barrels.

Started in second floor storage of finished barrels, containing but few barrels at time of fire.

Carelessness of employee suspected.

Three small fires occurred sometime previous to inspection, and owner did not remember details.

Matches or cigars thrown by outside parties onto pile of shavings suspected.

Fire originated in manufacturing room.....2

Fire was thought to have been caused by a large sanding belt or from wood-fired cooper stoves.

Fire originated in boiler room.....5

Fire occurred in frame Texas on roof over boiler room.

Fire discovered on roof of boiler room.

No details reported.....4

Fire discovered in stave mill.

Fire occurred in storehouse.

Fire occurred in stave storage.

Fire originated on roof of storage shed.

Fire originated near roof, probably from spark which had been smouldering for a long time.

Fire originated in finishing department.

2. MISCELLANEOUS STATISTICS.

Analysis of Losses.

Losses as Compared to Sprinklered and Unsprinklered.

	Sprinklered.		Unsprinklered.		Total.	
	No. of Fires.	Per cent of Sprinklered.	No. of Fires.	Per cent of Unsprinklered.	No. of Fires.	Per cent of total.
No Claim	40	63.5	1	2.0	41	37
Small	17	27.0	12	25.0	29	26
Large	6	9.5	35	73.0	41	37
Total	63		48		111	

*Relation Between Effect of Sprinklers and Losses.

	Extinguished.		Held in Check.		Unsatisfactory.	
	No. of Fires.	Per cent of Extinguished.	No. of Fires.	Per cent of Held in Check.	No. of Fires.	Per cent of Unsatisfactory.
No Claim	32	94	8	42	..	..
Small	2	6	10	53	2	29
Large	..	..	1	5	5	71
Total	34		19		7	

Losses as Compared to Causes.

Common Causes.

	Sprinklered.		Unsprinklered.		Total.	
	No. of Fires.	Per cent of Sprinklered.	No. of Fires.	Per cent of Unsprinklered.	No. of Fires.	Per cent of Common.
No Claim	19	73	1	6	20	49
Small	6	23	4	27	10	24
Large	1	4	10	67	11	27
Total	26		15		41	

Special Hazard Causes.

	Sprinklered.		Unsprinklered.		Total.	
	No. of Fires.	Per cent of Sprinklered	No. of Fires.	Per cent of Unsprinklered.	No. of Fires.	Per cent of Special.
No Claim	15	65	..	..	15	43
Small	6	26	3	25	9	25
Large	2	9	9	75	11	32
Total	23		12		35	

Unknown, Incendiary and Exposure.

	Sprinklered.		Unsprinklered.		Total.	
	No. of Fires.	Per cent of Sprinklered.	No. of Fires.	Per cent of Unsprinklered.	No. of Fires.	Per cent of Unknown.
No Claim	6	43	..	..	6	17
Small	5	36	5	24	10	29
Large	3	21	16	76	19	54
Total	14		21		35	

*Does not include three fires in which water was shut off or no heads operated.

3. ROOMS IN WHICH FIRE OCCURRED.

	Common Causes.		Special Hazards.		Unknown Incendiary Exposure.		Total No. of Fires.	
	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.
Barrel Heater Room	..	..	4	11.4	..	..	4	3.6
Boiler Room	16	39.0	1	2.8	7	20.0	24	21.6
Dry Kiln or Room	3	7.3	16	45.7	2	5.7	21	18.9
Engine Room	4	10.0	..	..	..	..	4	3.6
Fan Room	1	2.4	..	..	..	..	1	0.9
Finishing Department	..	..	..	..	1	2.8	1	0.9
Fuel Room	2	4.8	..	..	..	..	2	1.8
Hand Shop Department	1	2.4	1	2.8	..	..	2	1.8
Manufacturing floor	2	4.8	1	2.8	8	22.8	11	9.9
Oil Room	1	2.4	..	..	..	..	1	0.9
Roof	2	4.8	..	..	1	2.8	3	2.7
Shavings Vault	..	..	12	34.3	..	..	12	10.8
Stave Mill	..	..	..	..	1	2.8	1	0.9
Storage Room	3	7.3	..	..	2	5.7	5	4.5
Storehouse	3	7.3	..	..	4	11.4	7	6.3
Top Floor	1	2.4	..	..	..	..	1	0.9
No data	2	4.8	..	..	9	25.7	11	10.0
Total	41	99.7	35	99.8	35	99.7	111	100.0

4. DAY OR NIGHT FIRES. (Day Fires 6 a. m. to 6 p. m.)

	Common Causes.		Special Hazards.		Unknown Incendiary Exposure.		Total No. of Fires.	
	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.
Day	21	54	17	49	13	38	51	47
Night	18	46	18	51	21	62	57	53
Total with data given	39	100	35	100	34	100	108	100
No data	2	..	..	..	1	..	3	..
Total	41				35		111	..

5. PLANT IN OPERATION.

	Common Causes.		Special Hazards.		Unknown Incendiary Exposure.		Total No. of Fires.	
	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.
Plant in operation .	18	47	17	49	13	39	48	45
Plant not in operation	20	53	18	51	20	61	58	55
Total with data given	38	100	35	100	33	100	106	100
No data	3	..	..	..	2	..	5	..
Total . . .	41				35		111	

6. HOW DISCOVERED.

	Common Causes.		Special Hazards.		Unknown Incendiary Exposure.		Total No. of Fires.	
	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.
Employee . . .	15	38	14	40	10	30	39	36
Watchman . . .	11	28	9	26	11	34	31	29
Thermostat . . .	..	..	1	3	..	..	1	1
Sprinkler Alarm .	7	18	7	20	2	6	16	15
Outsider	6	16	4	11	10	30	20	19
Total with data given	39	100	35	100	33	100	107	100
No data	2	..	..	..	2	..	4	..
Total . . .	41				35		111	

SPRINKLER FIRE RECORD.

7. EFFECT OF SPRINKLERS.

	No. of Fires.	Per Cent of Whole.
Extinguished or practically extinguished fire	34	54
Held fire in check	19	30.1
Unsatisfactory (Water shut off in one case)	8	12.7
Fires extinguished before sprinklers operated	2	3.2
Total	63	100.0
No claim	40	63.3
Small loss (including three cases where sprinklers were not a factor)	17	27.0
Large loss	6	9.7
Total	63	100.0

8. DETAILS OF UNSATISFACTORY SPRINKLER FIRES.

1411. This was mostly a two-story building of wooden open joist construction. There were three dry kilns in west section of each floor, about sixteen by seventy-six feet each. The partitions between the kilns did not extend up between the ceiling joists. Kilns were heated by hot air blown over steam coils on first floor. Second story kilns received heat from those below through four openings, eight by sixteen inches, in floor of each kiln. There were twenty-one Manufacturers sprinklers, 300° solder, in each kiln. There were about 210 heads in each floor. Sprinklers were supplied by a 9,500-gallon gravity tank which gave a pressure of twelve pounds on top line of sprinklers. Second supply consisted of waterworks which gave a pressure of eighteen pounds on top line.

Fire discovered just after closing down at night in the center kiln on second floor, and cause was not determined. The hard solder heads were rather slow in acting; the kilns were full of stock; and the water pressure was weak; therefore, the fire was soon beyond control of sprinklers and all the kilns on second floor were destroyed. Also part of the walls and roof were badly burned. All of the sprinklers, about 210, opened. Not much fire penetrated to the first floor, but the heat opened a large number of heads, as follows: the sixty-three heads in dry kilns and ninety-four of the 147 outside of kiln; the twenty-seven heads in open saw shed did not operate, and fire did not attack the boiler room. A loss of $9,000 resulted.

Summary: High test heads, low water pressure and obstructions to distribution.

1679. Fire occurred in a stave kiln, eighteen by eighty feet and sixteen feet high. Brick walls, with brick arched ceiling and cement floor. Kiln contained 600,000 staves. Open joist ceiling about six feet above kiln. Sprinklers were Clapp No. 2, on dry system, controlled by a Clapp "Perfect" diaphragm dry valve. Primary water supply consisted of a 650-gallon automatic pump which gave a pressure of eighty pounds. Secondary supplies consisted of two 17,000-gallon gravity tanks and a 20,000-gallon duplex pump, which were called into use. Fire was extinguished by help of fire department and fire boat. Sprinklers were kept in service for twenty-four hours.

Fire was discovered at 7 a. m. on Sunday by ringing of sprinkler alarm, and automatic pump started immediately. The firemen opened iron doors of kiln, but the back draft scorched the men and the doors were immediately closed. Fire was fought by use of numerous hose streams through holes cut in the ends and top of kiln. Fire was controlled at about 1 p. m. Monday. Loss about $5,000.

2392. This was a large frame building of two stories, 400 by 100 feet, of poor open finish, joist construction. The entire top floor, excepting a small part used for cooperage work, was filled with finished sugar barrels. The barrels were made of kiln-dried lumber, covered on both ends, and were piled on end six deep, leaving about two feet clear for the sprinklers. The

fire started at end of the top floor and was discovered by a workman, who called to the watchman, who rang in the city fire alarm. The cause of the fire was unknown, but as the place where it started was only used for the storage of barrels, it suggested incendiarism, especially as a similar fire had previously occurred at this plant in the same room.

The sprinkler system was old, with a Clapp dry valve, and the arrangement of feed mains and pipe sizes was very poor. The sprinklers were Walworth ordinary pendant, and did all that could be expected of them. They had to work under great disadvantages; namely, severe occupancy, poor arrangement of feed mains and low pressure water supplies. The primary supply was low pressure waterworks, giving forty-five pounds street level, and the secondary supply was a gravity tank. A large number of sprinklers opened and practically no water was thrown from the end sprinklers because of the small pipe sizes and the lowering of the waterworks pressure by the fire engines. The gravity tank was practically emptied, although this may have happened in the interval between the shutting of the waterworks valve in the basement and the tank valve under the tank, the water running out through the large number of opened sprinklers. A heavy loss resulted.

Summary: Obstructions to distribution.

2419. Fire occurred in a top story room used for storage of barrels; ceiling of open joist. Building was equipped with Kane bulb root sprinklers, installed on old standard pipe system. Primary supply consisted of a 9,500-gallon gravity tank which gave a pressure of ten pounds on the top line. A secondary supply from waterworks was not of sufficient pressure to reach top floor. Cause of fire unknown. It spread rapidly and all the heads in room, 130, operated. Public fire department kept fire from entering lower floors. Top floor and contents were destroyed.

Summary: Deficient water supplies.

4611. Fire occurred in detached joist-constructed metal-clad boiler house, from unknown cause. Water was shut off sprinkler system during cold weather to prevent freezing, as system was not provided with a dry valve. Controlling valve was not opened until fire had gained too great a headway to be extinguished by the operation of the sprinklers.

Summary: Water shut off.

8007. Fire occurred in one-story frame detached building used as a header storage shed. This building was not sprinklered. It spread from here to the two-story sprinklered addition three feet distant, which was also destroyed. Fire was prevented from entering the main brick building by sprinklers and hose streams. The only supply to sprinklers was a 2,000-gallon pressure tank and 8,700-gallon gravity tank, and these supplies were soon exhausted.

Summary: Exposure fire.

8955. A small fire occurred in one of the dry kilns at 7 p. m. Cause unknown, but probably overheating of kiln. It was discovered by watchman, who notified the engineer in boiler house. Engineer immediately

went into first floor of mill, located the fire in kiln, hearing what he thought to be water and steam from sprinklers in operation.

Dry kiln was equipped with a system of Clapp No. 2, 286 degree sprinklers, and a few steam sprinklers. Automatic sprinklers were supplied by automatic pump, eighty pounds primary pressure. After the fire was out it was found that two steam and three automatic sprinklers had opened.

Engineer gave alarm and started fire pump at once, drafting from city main. The city department responded promptly. The south door of kiln was opened and fire attacked with hose streams from public and private hydrants. Fire was located in corner of kiln under a pile of staves, and as firemen could not enter on account of smoke, it was very difficult to fight.

It is stated that six smoke explosions occurred, and in one of these a man, who had managed to creep into kiln a short distance on the piles of staves, carrying a hose, was blown out through the door of kiln. Each explosion forced the single fire doors from kiln into first floor of main building slightly open, but they did not give way, holding fire in check at this point. The fire department wanted to open these doors so as to attack fire from first floor of main building, but were restrained.

After fighting the fire until about 2 a. m., at the suggestion of the fire chief a hole was broken through the west wall of kiln from engine room at a point opposite fire, and the extinguishment was then completed with hose streams about 3 a. m., after fire had been burning eight hours. Loss was slight.

Summary: Obstruction to distribution.

11590. Fire started in a frame unsprinklered dry kiln and communicated to immense piles of hard-wood staves in yard. These staves were piled irregularly and no clear space maintained between staves and buildings. Brick dry kiln, which was equipped with sprinklers, was surrounded by stave piles. Walls of this building were not parapetted, and there were several unprotected openings in same, through which the fire gained entrance. It is believed sprinklers in kiln were obstructed by stock, and when roof burned off the intense heat from burning yard rendered them of little service, and they were shut off by fire department.

Main building was exposed to intense heat during the fire, but owing to the effectiveness of the open sprinklers, along exposed side, practically no damage was done.

Summary: Exposure.

9. DETAILS OF LARGE LOSS SPRINKLER FIRES. (Where sprinkler control was satisfactory.)

10301. Fire occurred in manufacturing department with ceiling of open joist construction. The sprinkler equipment consisted of Grinnell and Manufacturers heads, installed in 1907 on an old schedule pipe system. There were 146 heads in room, supplied by a four-inch riser. Sprinklers were spaced ten by ten feet, not staggered. This was a dry system, con-

trolled by a Grinnell differential dry valve. About 200 heads on dry system. Primary water supply consisted of pressure tank which gave 80 pounds pressure on heads that operated.

Fire occurred at 1 a. m. from unknown cause, and electric alarm on dry valve notified the watchman. Forty-one sprinklers operated and held fire in check. Fire was extinguished with the assistance of the city fire department. A loss of $7,000 resulted.

The large number of sprinklers which opened was due to the fact that fire originated underneath a rack four feet wide. This rack contained staves and the arrangement prevented the proper distribution of water at the start of fire. The fact that heads were not staggered under joist construction enabled the heat to travel between joists the full width of the bay, thus opening more heads than would have otherwise happened had the system been arranged in standard manner.

S-12173. Fire occurred in a one-story storage shed twenty feet high, adjoining main factory. Building was equipped with Manufacturers type

S-12173.

* Shows the spot where the fire was first discovered by the watchman.

A sprinklers, supplied by city waterworks which gave a pressure of fifty pounds at sprinklers. The staves were tied in bundles and piled very solid to a height of about eighteen feet, having a passageway through the center of building, and owing to the height of building and stave piles and draft conditions, the sprinklers were a little slow in operating, and it was very hard for the water to reach the seat of the fire, as it seemed to eat its way through the small spaces between the piles. Watchman discovered fire partly on the inside and partly on the outside of wall. The fire seemed to

work its way between the stave piles and frame wall of building until it reached a point directly opposite a frame ventilator in roof which, owing to the draft conditions, attracted the fire to this ventilator. Watchman sent in alarm to fire department, and when they arrived the sixty-three sprinklers in room were in operation and had practically confined the fire to one corner of the building and kept it from communicating to factory building. In spite of the severe handicap under which the sprinklers operated, it was clearly demonstrated that had it not been for the automatic sprinklers holding the fire in check until the fire department arrived, in all probability the result would have been a total loss of the factory buildings. Loss $15,000.

10. POINTS OF INTEREST FROM FIRE REPORTS.

Miscellaneous.

H-6471. Fire caused by locomotive sparks on shingled roof.

All roofs should have a fire-resistive covering, especially when buildings are near railroad tracks.

H-6712. Fire originated in power house and plant was destroyed. Build detached brick boiler houses.

H-2305. Fire discovered by outsider. Total loss resulted. Watchman's service should have been provided.

H-4953. A pile of stock twenty feet from building, which was destroyed, was saved by use of private hydrants and volunteer department.

H-7093. To lack of proper cut-offs between buildings was due the total destruction of plant from fire which originated in dry kiln.

H-107. Keep steam pipes away from woodwork in all cases. Large loss resulted from this condition.

S-7898. Wire lath and plaster ceiling was put in sprinklered dry kiln at a distance of about four feet below the sprinklers, leaving the drying space unprotected. Owners declined to provide this space with sprinklers. Fire broke out here and sprinklers were of no value, plant being totally destroyed.

11. NUMBER OF SPRINKLERS OPENED.

No. of Sprinklers Operating.	Extinguished Fire. No. of Fires.	Extinguished Fire. Per Cent.	Held Fire in Check. No. of Fires.	Held Fire in Check. Per Cent.	Unsatisfactory. No. of Fires.	Total. No. of Fires.	Total. Per Cent.	No. of Sprinklers Operating.	No. of Fires.	Per Cent of Whole.
1	5	14.7	2	10.5	..	7	11.7	1	7	11.7
2	12	35.3	3	15.8	1	16	26.7	2 or less	23	38.3
3	5	14.7	5	26.3	..	10	16.7	3 or less	33	55.0
4	1	2.9	4	21.0	..	5	8.3	4 or less	38	63.3
5	2	5.9	..	..	..	2	3.3	5 or less	40	66.6
6 to 9 inc.	7	20.6	1	5.3	..	8	13.3	Less than 10	48	80.0
10 to 24 inc.	..	..	1	5.3	1	2	3.3	Less than 25	50	83.3
25 to 49 inc.	2	5.9	3	15.8	2	7	11.7	Less than 50	57	95.0
50 and over	..	..	..	..	3	3	5.0	50 and over	3	5.0
Total.....	34	100	19	100	7	60	100			

Average number of sprinklers opened, not including unsatisfactory, 6.3.

12. ALARM SERVICE. Fires Satisfactorily Discovered by one Agency Alone. Failures not Included.

	No. of Fires.	Per Cent.
Watchman	18	32
Sprinkler alarm	12	22
Employee	26	46
Total	56	100

Efficiency of Alarm Service where More than One Agency was a Factor.

	Watchman.		Sprinkler Alarm.		Thermostat.		Employee.		Total.
	Satisfactory.	Failure.	Satisfactory.	Failure.	Satisfactory.	Failure.	Satisfactory.	Failure.	
Watchman and sprinkler alarm	2	1	3	..	..	..	..	..	5
Watchman and Thermostats	..	1	..	..	1	..	..	..	1
Sprinkler alarm and employee	..	..	..	1	..	..	1	..	1
Total									7

13. SECONDARY WATER SUPPLIES.

Summary.

There were twelve fires, or twenty per cent, in which the secondary supply was a factor in the sprinkler protection. Of these, one was practically extinguished, six were held in check, and five resulted in failure. Four of these fires resulted in no claim, three in a small loss, and in five cases a large loss resulted. Outside protection was a factor in the final extinguishment in eleven cases, and in one case inside protection was a factor.

Details.

1411. Primary supply was waterworks which gave eighteen pounds pressure on first of three hundred sprinklers that operated. A 9,500-gallon gravity tank, which gave a static pressure of twelve pounds on the sprinklers, was drained. Sprinklers failed to control the fire.

1589. Primary supply was automatic steam pump which gave seventy pounds pressure on first of forty-one sprinklers that operated. Secondary supply, consisting of waterworks, said to have been drawn upon. Sprinklers entirely extinguished the fire.

1679. Primary supply was a 650-gallon automatic steam pump which gave eighty pounds pressure on first of eighteen sprinklers that operated. Second supplies consisting of two 17,000-gallon tanks and a 2,000-gallon

duplex steam pump, said to have been called upon. Sprinklers failed to extinguish the fire.

2392. Primary supply was waterworks, which gave about thirty pounds pressure on first of 330 sprinklers that operated. The gravity tank, which was the secondary supply, was found to be practically empty after the fire. Sprinklers failed to extinguish the fire.

2419. Primary supply was a 9,500 gallon gravity tank, which gave about eleven pounds pressure on the first of 130 sprinklers that operated. The second supply consisted of waterworks, but of such a poor pressure that it was practically useless at the top floor where fire occurred, with so many heads open. Sprinklers failed to control fire.

6442. Primary supply was a pressure tank, which gave eighty pounds pressure on the first of three sprinklers that operated. The secondary supply, consisting of waterworks, said to have been a factor in extinguishing the fire. Sprinklers held fire in check.

7308. Primary supply was a 2,500-gallon pressure tank which gave eighty pounds pressure on the first of seven sprinklers that operated. City waterworks, with a pressure of sixty pounds, became a factor. Sprinklers held fire in check.

8007. Primary supply was a 3,000-gallon pressure tank which gave about eighty pounds pressure on first of thirty-two heads that operated. Secondary supply consisted of an 8,700-gallon gravity tank. Both supplies were exhausted. Sprinklers failed to control fire.

10301. Primary supply was pressure tank which gave eighty pounds pressure on the first of forty-one sprinklers that operated. Secondary supplies, consisting of gravity tank, waterworks and steamer connection, were brought into use. Sprinklers held fire in check.

10420. Primary supply was pressure tank which gave eighty-five pounds pressure on first of three sprinklers that operated. The secondary supply, consisting of waterworks, said to have been used. Sprinklers held fire in check.

11518. Primary supply was pressure tank which gave eighty pounds pressure on first of four sprinklers that operated. The secondary supply consisted of waterworks and steamer connection which were said to have been used. Sprinklers held fire in check.

11638. Primary supply was automatic steam pump which gave a pressure of ninety pounds on the first of thirty sprinklers that operated. Secondary supply, consisting of waterworks, said to have been a factor. Sprinklers held fire in check.

14. EFFICIENCY OF WATER SUPPLIES TO SPRINKLER SYSTEMS.

Primary Water Supply.	Number of fires	Per cent. of fires	Average pressure	Average number sprinklers opened	Per Cent. of Fires.			Average Pressure.			Average Number Sprinklers Opened	
					Extinguished fire (or practically extinguished)	Held fire in check	Unsatisfactory	Extinguished fire (or practically extinguished)	Held fire in check	Unsatisfactory	Extinguished fire (or practically extinguished)	Held fire in check
Waterworks,	30	50.0	77.5	4.2	33.3	11.7	5.0	88.7	60.0	43.3	4.9	2.4
Gravity tank,	5	8.3	21.4	9.7	5.0	1.6	1.6	27.3	15.0	10.0	4.6	25.0
Pressure tank,	15	25.0	78.0	5.7	11.7	11.7	1.6	80.7	80.7	40.0	2.3	9.1
Automatic pump,	10	16.7	73.0	12.4	6.7	6.7	3.4	77.5	65.0	80.0	13.0	11.7
Total,	60	100.0	72.2	6.3	56.7	31.7	11.6	80.4	66.3	48.6	5.3	8.0

15. EFFICIENCY OF WATER PRESSURES ON SPRINKLER SYSTEMS.

Pressure on Sprinklers.	Number of fires	Per cent. of fires	Average pressure	Average number sprinklers opened	Per Cent. of Fires.			Average Pressure.			Average Number Sprinklers Opened	
					Extinguished fire (or practically extinguished)	Held fire in check	Unsatisfactory	Extinguished fire (or practically extinguished)	Held fire in check	Unsatisfactory	Extinguished fire (or practically extinguished)	Held fire in check
Less than 15 lbs.,	1	1.7	10.0	..	..	..	1.6	..	..	10.0	..	..
15 to 24 inclusive,	6	10.0	19.2	9.2	3.4	5.0	1.6	21.0	18.3	18.0	3.5	13.0
25 to 49 inclusive,	6	10.0	38.6	3.5	5.0	1.7	3.4	38.3	45.0	36.0	3.6	3.0
50 and over,	47	78.3	84.6	6.2	48.3	25.0	5.0	88.8	77.3	80.0	5.6	7.4
Total,	60	100.0	72.2	6.3	56.7	31.7	11.6	80.4	66.3	48.6	5.3	8.0

16. EFFICIENCY OF WET OR DRY SPRINKLER SYSTEMS.

Wet or Dry System.	Number of fires	Per cent. of fires	Average pressure	Average number sprinklers opened	Per Cent. of Fires.			Average Pressure.			Average Number Sprinklers Opened	
					Extinguished fire (or practically extinguished)	Held fire in check	Unsatisfactory	Extinguished fire (or practically extinguished)	Held fire in check	Unsatisfactory	Extinguished fire (or practically extinguished)	Held fire in check
Wet system,	8	13.4	56.9	1.8	5.0	3.4	5.0	64.0	77.5	36.0	1.3	2.5
Dry system,	52	86.6	74.5	6.7	51.7	28.3	6.6	81.9	65.0	58.0	5.7	8.7
Total,	60	100.0	72.2	6.3	56.7	31.7	11.6	80.4	66.3	48.6	5.3	8.0

Note—"Average number of sprinklers opened" does not in any case include the Unsatisfactory fires.

17. EFFICIENCY OF WATER SUPPLIES TO SPRINKLER SYSTEMS —As Regards Amount of Loss.

Primary Water Supply.	Number of fires	Per cent. of fires	Average pressure	Average number sprinklers opened	Per Cent. of Fires.			Average Pressure.			Average Number Sprinklers Opened.		
					No claim	Small loss	Large loss	No claim	Small loss	Large loss	No claim	Small loss	Large loss
Waterworks,	30	50.0	77.5	4.2	36.7	8.3	5.0	81.8	79.0	43.3	4.6	4.0	..
Gravity tank,	5	8.3	21.4	9.7	5.0	1.7	1.7	27.3	15.0	10.0	4.6	25.0	..
Pressure tank,	15	25.0	78.0	5.7	18.3	3.3	3.3	80.9	80.0	60.0	2.7	4.5	41
Automatic pump,	10	16.7	73.0	12.4	6.7	10.0	..	77.5	70.0	..	13.0	11.7	..
Total,	60	100.0	72.2	6.3	66.7	23.3	10.0	77.0	70.7	43.3	4.7	8.4	41

18. EFFICIENCY OF WATER PRESSURES ON SPRINKLER SYSTEMS —As Regards Amount of Loss.

Pressure on Sprinklers.	Number of fires	Per cent. of fires	Average pressure	Average number sprinklers opened	Per Cent. of Fires.			Average Pressure.			Average Number Sprinklers Opened.		
					No claim	Small loss	Large loss	No claim	Small loss	Large loss	No claim	Small loss	Large loss
Less than 15 lbs.,	1	1.7	10.0	..	..	..	1.7	..	..	10.0	..	..	..
15 to 24 inclusive,	6	10.0	19.2	9.2	5.0	3.3	1.7	20.6	17.5	18.0	3.3	18.0	..
25 to 49 inclusive,	6	10.0	38.6	3.5	5.0	1.7	3.3	38.3	45.0	36.0	3.6	3.0	..
50 and over,	47	78.3	84.6	6.2	56.7	18.3	3.3	85.4	82.7	80.0	5.0	6.9	41
Total,	60	100.0	72.2	6.3	66.7	23.3	10.0	77.0	70.7	43.3	4.7	8.4	41

19. EFFICIENCY OF WET OR DRY SPRINKLER SYSTEMS. —As Regards Amount of Loss.

Wet or Dry System.	Number of fires	Per cent. of fires	Average pressure	Average number sprinklers opened	Per Cent. of Fires.			Average Pressure.			Average Number Sprinklers Opened.		
					No claim	Small loss	Large loss	No claim	Small loss	Large loss	No claim	Small loss	Large loss
Wet system,	8	13.4	56.9	1.8	6.7	3.3	3.3	64.2	85.0	14.0	1.2	4.0	..
Dry system,	52	86.6	74.5	6.7	60.0	20.0	6.7	78.5	68.3	58.0	5.2	8.8	41
Total,	60	100.0	72.2	6.3	66.7	23.3	10.0	77.0	70.7	43.3	4.7	8.4	41

Note—"Average number of sprinklers opened" does not in any case include the Unsatisfactory fires.

GENERAL FIRE RECORD.

Unsatisfactory or Serious Fires in Buildings Equipped with Sprinklers.

Where sprinklers fail the cause is, almost invariably, clear. These fires are selected to indicate such causes, that they may be generally understood and satisfactorily met.

S-12118. Sash, Door and Blind Factory. This was an old building of light joist construction, with brick veneer walls, and in poor repair. It was equipped with Esty No. 5 sprinklers on an old schedule dry pipe system, with a Manufacturers dry valve. The pipes drained poorly. There were over 500 heads on the system. There were two six-inch connections from a ten-inch waterworks main, having a pressure of ninety pounds. Watchman had left and fire was discovered by watchman of nearby plant at 6.30 a. m., January 29, 1912, on the first floor. The building collapsed in an hour. The first arrivals stated that the sprinklers were in operation. If they were in operation they certainly did not hold the fire.

The east section of the ground floor, where the fire apparently started, was not heated, but the balance of the building was heated by steam, and the dry valve closet was heated by steam, and the owners claim steam was on the building over Saturday and Sunday. The place where one of the owners saw the sprinklers discharging water was in the open shed near the west side, and some distance from where the fire started. His theory was that the fire, starting in a far corner from the dry pipe valve and the pipes being so very cold on account of the climatic conditions, the water in the pipes froze before it reached the opened sprinklers, and in this way the fire got a good start. This does not seem to be a very reasonable theory, however, on account of the comparatively small size of the building. It is reasonable to account, however, for the failure of the sprinklers by the fact that the dry valve or the supply pipe was frozen. The temperature on the morning of the fire was very low, and if the dry valve operated slowly the working parts might have become frozen even if the system had been in order at the start of the fire. The six-inch feed for the dry valve was run at the bottom of the tailrace and passed up through the race to the dry valve closet, which was located about the center of the mill. There was apparently a space of about eighteen inches from the water level of the tailrace to the floor of the mill, and this supply pipe may have been frozen at the start of the fire. A total loss resulted.

Summary: Sprinkler system crippled, due to freezing.

S-11778. Tenant Manufacturing. This was a three-story brick building of open joist construction. The stairways were enclosed with one-inch boards, first to second floor, and open from second to third floor. There were several small belt hole openings from the first to the second floor. Part of the first floor, where fire originated from unknown cause, was occupied by a waxed paper concern, and the remainder of the building was occupied by a manufactory of vegetable ivory buttons. Fire was discovered by an employee at 11.14 a. m. Fire spread so rapidly that it was with difficulty that all the employees got out of the building.

Building was equipped with Grinnell glass disc sprinklers, wet-pipe system, supplied by city waterworks at thirty-five pounds pressure from a six-inch main through a four-inch connection, and an 8,000-gallon gravity tank located twenty feet above building. The supplies were classed as a deficient primary supply. Pipe sizes were old standard and spacing not over eight by ten feet under the joist, and no recognized second supply. There were seventy-nine sprinklers on the first floor, fifty-one of which opened; seventy-four on the second floor, fifty-seven of which opened; and seventy sprinklers on the top floor, all of which opened. The large number of heads which opened on the second and third floors was due more to the banking up of the severe heat than to the actual flame, which rapidly spread through the belt holes to second floor and open stairway to third floor. The fire department had seventeen streams on the fire and eight engines in service. The sprinkler tank was emptied at once and the sprinklers probably had very little, if any, water from the city main after the engines were in service. A large loss resulted.

Summary: Unprotected floor openings and deficient water supplies.

S-12450. Paper Mill. The boiler house, where fire occurred, was one high story with plank roof on steel trusses. In one corner there was a boiler with a Dutch oven which was used for burning the shavings and waste chips from the pulp screens. These chips were brought over from the screen building through a conveyor which passed over the roofs of several of the buildings and discharged into a chip bin on the roof of the boiler house. This chip bin had an iron hopper bottom which discharged through a galvanized iron pipe onto the firing floor near the Dutch oven. Shavings were also brought from the carpenter shop through the beater engine building and dumped through a doorway directly above this firing floor.

An accumulation of shavings had gathered in the corner, and it is supposed that these fired back from the Dutch oven. The fire was first seen flashing up the side wall. It spread rapidly to the roof and burned into the cornice of the monitors and also into the side frame of the chip bin on the roof. An alarm was immediately given and six hose lines were laid for hydrants, two of these lines being used inside the boiler house and four on the roof. Some little delay probably occurred due to the height of the roof and its comparative inaccessibility because of surrounding buildings.

Practically all of the sprinklers in the boiler house were opened during the fire, but because of the foulness of the water those which first opened in

the vicinity of the fire were quickly plugged with chips and sediment. Four sprinklers in the chip bin on the roof and one sprinkler in the conveyor nearby opened, but these sprinklers were fed from dry-pipe system controlling No. 1 storehouse at the other end of the plant and apparently experienced no trouble from plugging up, as they completely extinguished the fire in the chip bin. The 1,000-gallon steam pump was started soon after the fire began and was run for approximately thirty minutes when it was found necessary to shut it down because of choking up. The small auxiliary pump was also run some of the time. The rotary pumps were not started. After about thirty minutes it was noticed that the sprinklers had so badly plugged that they were of little value and they were shut off entirely and the fire gradually extinguished with hose streams. Loss between $2,000 and $3,000.

Summary: Plugged heads.

S-12153. Tenant Manufacturing. On Sunday at about 3.52 p. m., the engineer while sitting in engine room smelled smoke and went into the boiler room, where he discovered fire burning over the boiler among the joists, which are eighteen inches from top of boiler and not protected by metal. The sprinklers here had not yet opened and there were neither chemical extinguishers nor hand hose about, so he ran at once to the insurance patrol, a block away, arriving at 3.55 p. m., gave the alarm and ran back to factory. The patrol followed him into the yard and at once played a chemical stream on fire in basement. Sprinklers were open here when they arrived. A policeman entered the yard behind the patrol and entered basement with the captain of patrol. He then ran out and sent in an alarm to city department, which arrived in a few minutes. Engineer states that he first heard the sprinkler alarm as he was opening a gate to allow city department to enter alley along north of building.

The firemen entered first floor and found fire burning the floor, window casings, walls and ceiling at north center of floor, and several sprinklers open. Streams were at once turned on the fire, and other firemen entered second floor and found fire coming up through a belt hole directly over boilers in basement and being held down somewhat by one sprinkler which had opened. One stream was used here. In all fifteen sprinklers opened, three in basement, eleven in first floor and one in second floor. These operated for about twenty-five minutes, when the 5,000-gallon sprinkler tank, which comprised the primary supply, was emptied. There was no secondary supply. City department soon had fire under control and left factory about 4.45 p. m. Six engine companies were used, each supplying one stream. Only a moderate loss resulted.

Summary: Floor openings.

S-11932. Linoleum Works. Fire occurred in building of brick plank and timber construction, 222 by 73 feet. Building was four stories high. Floors were of three-inch plank splined and grooved. First floor was concrete. Stairs were in a small brick tower with a good self-closing tin-clad fire door at top and bottom of stairway each floor. Opposite this stair tower

and in middle of building was an open elevator shaft, three feet by sixteen feet. A one-inch trap door, covered on underside with galvanized iron (nailed on), was located at fourth floor, trap being raised by car. The first, second and third floors were open at time of fire. Roof was of two-inch plank on girders and beams, very similar to the floor construction, and had a slag covering. There were several unprotected belt holes.

Building was occupied largely as a storehouse. First floor contained a large stock of printed linoleum, a good part of which was put up in crates ready for shipping. Also 180 rolls of unprinted linoleum, which had been taken from dry room on the afternoon before the fire, were stored here. Fourth story was occupied as a drying or seasoning room for inlaid linoleum. There were two dry rooms the width of building and a little over ninety feet long on this floor, with a space of about thirty feet in middle of building between dry rooms. Ends of dry rooms were frame. Drying racks were entirely of iron and steampipes were located at sides on iron brackets. The total capacity of these dry rooms was 33,600 square yards. At time of fire, these racks were fairly well filled.

The protection in building consisted of a good supply of fire pails on all floors, and the fourth floor was also equipped with Grinnell glass disc 212 degree sprinklers. System was supplied by a 50,000-gallon steel gravity tank, 100 feet above ground and fifty feet above the highest sprinklers in building, and also by a 1,000-gallon and 430-gallon fire pump, drafting from 122,000-gallon reservoir. Gravity tank was the primary supply, giving approximately thirty-five pounds pressure on top lines. Sprinklers were spaced eight feet apart across the ceiling pockets, and six to seven feet with the pockets, and apparently staggered. The number of sprinklers was something over 200.

Fire discovered by watchman about 9 p. m. on first floor among some rolls of linoleum. Cause could not be ascertained. Watchman did not attempt to extinguish fire with the buckets of water near, and any such efforts would probably have been futile, but he promptly ran to boiler house and blew fire whistle and then turned in alarm from box in office. When watchman first discovered fire it was burning over a space perhaps four by six feet, and when the first man got into first floor after whistle had been blown, fire had begun to attack ceiling. The hands got on streams from yard hydrants of plant and the city department also got on several streams, two engines being located at private reservoir and drafting from it. The eight, six and four-inch filling pipes into reservoir from city mains were all opened wide and these, together with the small stream, furnished water enough for both fire pumps of factory and the two city steamers, so that water level in reservoir was not lowered.

The dense smoke made it difficult to approach building, and for several hours hose streams were poured into building without controlling fire, and it is said that very little fire was seen at times. The fire department is said to have felt very anxious about the danger of smoke explosion, but fortunately this did not occur. Both fire pumps at risk had been started early in

the evening, and it was said eighty pounds pressure held on yard hydrants and sprinkler system. This pressure gradually reduced as water in 50,000-gallon gravity tank got low, and finally tank was emptied altogether. Pressure then fell to fifty pounds. At about 2.30 a. m. it appeared as if one of the six-inch sprinkler risers had broken in fourth floor, and pressure dropped to twenty-eight pounds, both pumps running full speed. About this time one of the district engineers came to superintendent of factory and said that they would have to shut off sprinkler system in fourth floor and let fire burn out through roof so the department could get at it. The indicator valves controlling sprinklers were therefore closed, and in ten minutes fire was blazing out through roof of building 100 feet high, and in thirty minutes roof had fallen in. When this happened it was comparatively easy to reach fire and numerous streams were poured into building from roof of an adjacent building, so that by morning fire was well under control.

A large loss resulted on building, and total loss on contents.

Summary: Unsprinklered portions.

S–12048. Tenant Manufacturing. This fire started in an unsprinklered exposing basement-and-six-story building and extended into and destroyed this sprinklered basement-and-seven-story brick building, which was of light joist construction. The destruction of the sprinklered building can be attributed to four causes: first, unprotected windows across forty-foot space in high walls of considerable area; second, falling out of facing wall of exposure onto part of sprinklered buildings, sending fire into one-story section of sprinklered building, which opened into main building without cut off, and breaking one or more sprinkler pipes; third, single water supply of limited capacity for sprinklered building, with old standard piping; fourth, light floor construction, with considerable floor load. Of these four contributing causes, the first two were probably the chief factors, as these resulted in igniting the sprinklered building on all floors, practically simultaneously, which backed by the tremendous heat no doubt resulted in the fusing of a large number of sprinklers on every floor (126 heads on a floor). The primary supply consisted of a 13,600-gallon tank, which gave a pressure of fourteen pounds on the top line of sprinklers. Two steamer connections were used and supplied water to sprinklers until walls fell.

Practically a total loss resulted.

Summary: Exposure fire.

S–12097. Cotton Seed Oil Mill. This was a very large iron-clad one-story building, covering about two acres. Fire due probably to spark in sand boll screen of seed-cleaning machinery, and was discovered by an employee. Sprinklers were Grinnell glass disc, supplied by a 25,000-gallon gravity tank. Secondary pump supply was out of service, pending repairs, and waterworks supply was usually kept shut. Heads opened promptly but failed to control fire, probably because of headway gained in unsprinklered seed-cleaning machinery. Complete distruction of plant due to poor maintenance of fire appliances, lack of organized fire brigade and proper fire stops.

Summary: Insufficient water supplies.

S-11670. Yarn Dye Works. Fire occurred on Tuesday, October 10, 1911, at about 9.20 p. m., destroying the two upper stories of the three-story portion (which is the east end) of the manufacturing building. The west portion was wet down. The loss was about 50 per cent. The water supply to the sprinklers appears to have been cut off in some way, causing practically a sprinkler failure in the east section. In the west portion, where there was a separate riser with connection to yard mains, the sprinklers held the fire satisfactorily.

Start of Fire. The fire apparently started on the second story, in a yarn dry room, about in the center of the building. It was the custom of the night watchman to make a round just after work ceased at 6 o'clock. He then attended to the kiers and the boilers, not starting his second round until 9 o'clock. After 9 p. m. hourly rounds were maintained until 4 a. m. The watchman made his regular round at 6.30, finding everything satisfactory. There was an employee working where the fire started until about 7.20, when he went home. He filled up the most westerly dryer with wet yarn and turned on the steam. The dryer next east had steam turned on in the late afternoon. This man stated that all was as usual when he left.

The fire probably started from carbonization of the woodwork or steam pipes in contact with some combustible material in the dryer. The dryers were light wooden rooms about 12-feet wide by 25-feet long, extending the full height of the room. The steam coils were about eight inches from the floor, resting on iron rods, which in turn rested on wooden stringers. The yarn, in skeins, was hung on rods so as to be 18 to 24-inches clear of the steam coils. All yarns were of cotton. The steam was direct, pressure 40 to 50 lbs. This system of drying had been in use since the plant was built.

Construction and Occupancy. The building was 275 x 60 feet, with one-story brick boiler house, engine room and bleachery additions in the rear. The walls were wood; floors and roofs light joisted. The building was two stories high for 130 feet from the west end. The east portion was three stories and basement, with a slate roof having about a 25 per cent pitch. There were numerous open beltways, stairs and elevators. The floors were partly single boarded, and the whole construction of a light, quick burning type. The occupancy of the rooms was as follows: basement, bleachery; first floor, dyeing, drug rooms, washing, kiers and storage of yarns in process; second floor, office, yarn drying, winding, quilling, beaming, etc.; third floor, yarn drying, spooling and dressing.

Protection. The building was equipped in 1898 with Grinnell glass button sprinklers; 1-2-3 schedule of piping. The equipment was standard except for a few places where the spacing was a little excessive. The use of many high tests heads (286°) was also considered a slight defect.

The supplies were the two city water services, a 12-inches high at 140 lbs. and a 6-inches low at 70 lbs., the low being fed but one way.

The high service had a short 10-inch connection from a 12-inch main in the street. There was a 10-inch Gemmeter in connection.

The low service had a 6-inch connection from a 6-inch street main 600 feet

to an 8-inch. The two connections feed an 8-inch yard main from which two 6-inch pipes with post valves supplied respectively the east and the west portions. There were also gate valves inside the building. Six-inch alarm valves had been put on the pipes at the request of the water department for detectors, but they had never been connected to gongs. There were also standpipes, chemicals and pails, apparently not used during the fire.

Story of the Fire. The night watchman, who was in the building alone when the fire started, stated to the owner that when about to start on his 9 o'clock round, from the boiler room where he was at work, he heard water running down the main belt box from the mill to the engine room. He stated that he went upstairs and found smoke, and on opening a dry room he saw what appeared to be a small fire in the dryer room. At least one sprinkler was in operation. He claims to have hesitated between using a chemical and going at once to ring in an alarm. He took the latter course, probably leaving the dry room door open and ran to the box about 400 feet east of factory. The fire department must have arrived within three or four minutes. Fire was extending across the mill and in the second and third stories when they arrived. The first alarm was at 9.27, which brought two steamers, ladders, and hose carts. At 9.38 a second alarm was given, calling two more steamers and other apparatus. The patrol arrived within five minutes. The fire department chief stated that the water supply was ample. All stated that the fire was well under-way and spreading rapidly when they arrived. Also that the sprinklers could not have been in operation, judging from the action of the fire and from the absence of water coming through the floors.

The fire department confined the fire to the 3-story section and to the two upper stories, excepting slight damage to the roof of the brick bleachery building. Thirteen streams were used.

Ten sprinklers in the second story of the west portion, which was partially shut off by a wooden partition, opened and effectively aided in keeping the fire out of this part of the plant. It was very apparent from a study of the ruins that the sprinklers in the west portion were properly supplied with water and those in the east portion were not. At about midnight members of the fire department entered the basement of the east section and closed the sprinkler valve which, they claimed, was wide open. The owner examined this valve at about 2 a.m. and found it closed, which seems to corroborate the testimony of the firemen.

Probable Cause of Failure. It was the general opinion that, even though the valve was found open by the firemen, it must have been closed at the time the fire was spreading.

The poor construction, very dry woodwork of the dryers, and high test heads all might lead one to assume that the fire spread too rapidly for the sprinklers to control, but considering the unusually good water supply, the testimony of the fire department officers and the fact that sprinklers in the west section (one of which was a high test head) did excellent work, one is forced to conclude that the sprinklers in the east portion did not get water.

Owing to corrosive troubles in the dyeing portions of this plant, it has been necessary to shut off sprinklers for repairs frequently. The last of this work was done on Friday, October 6th. The master mechanic always gave this work his personal attention, and he was seen by the owner to operate the post valve outside, instead of the inside valve, in accordance with his instructions and custom. The repair work done Friday was properly plugged, and it is probable that the mechanic left the system in good condition. There were no corroded sprinklers.

There was a valve inspection service maintained, the head shipper making reports every Friday, as a check on work of the mechanic. This man, however, stated that on the previous Friday he neglected to inspect the valve himself, but meeting the mechanic in the basement, he took his word as to the valve being open. Therefore the valve had not been inspected, except by the mechanic, for two weeks. The seal was known to have been broken for some weeks.

The sprinklers at the start of the fire apparently had some water, as the first trouble noted was the water coming down the beltway. This might have been the water locked in the system, if the system had not been drained. The water in the third story piping would have supplied one or two sprinklers in the dry room for a short time until the fire spread out of the dryer to other portions of the building, where there would be no water. The mechanic or watchman might have opened the valve later during the fire, as it was found open by the firemen.

Another possible explanation of the fire was given as follows. The fire which occurred in the dry room was practically being held by one or a few sprinklers. The watchman, being busy with his kiers and boilers, heard the water running down the beltway and went out into the basement adjoining and closed the valve, thinking a sprinkler had opened accidentally, which was not an unknown incident in this plant. He might have delayed the investigation until it was time for his 9 o'clock round, and then on reaching the upper floors and finding a fire had worked out of the dry rooms, have forgotten to again open the sprinkler valve before going to the fire alarm box. Later, unobserved, a person could have passed into the basement and opened the valve as found by a captain of the fire department.

The only other conclusion would be that the pipe to the sprinklers in the east section had become obstructed in some manner.

This matter was investigated and no evidence of obstruction found. The alarm valve was opened and found free from foreign material. Any obstruction of any great size would have stuck in this alarm valve, as it was of the type having many ribs crossing the pipe area. The valve was opened and a free flow obtained out of the 6-inch cover opening of the alarm valve. This examination showed the pipe to be free. The post valve was used for controlling the water, and it was in good condition. The meter did not obstruct the flow materially, as the hydrant which it also controlled furnished ample water during the fire. The meter reading showed that a large amount of water had passed through the meter.

The conclusion must be that the valve was closed either through the carelessness of the mechanic or the poor judgment of the watchman. Loss about $66,000.

A point brought out by this fire was the necessity for watchmen to make hourly rounds from time of closing until factory starts in the morning.

S-11607. Retail Dry Goods Store. Three fires occurred on September fourteenth and fifteenth. This was a brick building, four stories high with attic. Floors had concealed spaces. Building was provided with a good wet-pipe sprinkler system, which had a primary supply from city water and secondary supply from a 10,000-gallon tank The primary supply gave fifty-three pounds on top line and the secondary supply gave twelve pounds. The fourth floor contained some electric pressing irons. Irons were not all provided with individual fuses and switches nor provided with pilot lights.

On September fourteenth at 10 p. m. a policeman heard sprinkler alarm, but did not pay any attention to it until he saw smoke issuing from windows on top floor, when he turned in alarm.

Exact cause of fire was not ascertained, but thought to be due to current being left on electric irons. When fire department arrived fire was found near electric irons on tables, top floor near north wall. Three or four sprinklers opened in vicinity and held fire under control, practically extinguishing it, but fire department had to use chemicals. The valves controlling sprinklers on this floor and attic were then closed, but afterwards attic valve was opened. About ten minutes was lost in locating ladder and sprinkler controlling valve. After the fire was supposed to have been extinguished, the chief instructed one of his men to remain on the scene until 2.30 a. m. to see if any further fire developed. There were also two clerks and a policeman on first floor who remained all night. The fireman, before leaving at 2 30 a. m., claims that in company with policeman and an employee he made a thorough search for fire, but finding no evidence, acted upon instructions of chief, left the building without relief. At 5.09 the next morning a passing newsboy noticed fire on top floor and turned in alarm. This time the fire had gained considerable headway. About fourteen per cent of heads in attic opened and saved the roof: the sprinklers on fourth floor, eighty-four in all (but three or four having previously opened first fire) opened, but valve had been closed after extinguishing blaze the night before. The fireman tried to reach this valve, but could not do so on account of heat. The blaze was finally subdued, however, by the use of three streams from engine, and afterwards attic valve was closed to prevent further water damage. Friday night, September fifteenth, a fireman was sent to see if any further fire existed and he found a box of burning hosiery on top floor. This fire was stamped out.

The second fire is supposed to have been but a continuation of the first fire, caused by spark lodging in goods or closets. The second fire occurred near west wall slightly to north of elevator. The third fire was discovered

in its incipiency near north central part of building; probably caused in like manner as second fire.

The sprinkler equipment worked admirably in practically extinguishing the first fire, but could not be expected to handle the second fire, as valve controlling sprinklers on top floor had been closed the night before to prevent further water damage. With proper care this second fire should not have occurred, or would have been easily extinguished by chemicals. A fireman should have kept watch all night, considering the nature of goods stored, class of construction, the large values at stake and the fact that the sprinklers on top floor were shut off. This second fire caused heavy damage. It is roughly estimated that the first fire did not cause over twenty per cent of total damage.

Buildings where fires have occurred should be kept under strict surveillance until all danger from rekindling of fire is past.

S–11876. Saw and planing Mill. Fire originated in sawdust room from a spark. There were seventy-five Neracher sprinklers in room, supplied by waterworks at seventy-five pounds pressure. This was a dry system, controlled by an old Manufacturers dry valve. Twenty-seven heads opened, but failed to control the fire.

Summary: Cause of failure not determined.

12037. Newspaper Publishing House. Fire caused by boy throwing a cigarette in waste paper basket. There were four Grinnell heads in room and one opened promptly, but only mud issued and head completely clogged. Only a slight water flow signal was received at the central station from automatic alarm. Fire was extinguished by use of water pails and chemical extinguishers.

Summary: Pipes clogged with mud.

S–12384. Rag Warehouse. This was a two-story brick building, seventy-five by one hundred and sixty, with heavy wood floors supported by large unprotected steel posts and girders. Stairway and elevator openings were unprotected. Building was equipped with Manufacturers sprinklers, supplied by a gravity tank as primary supply and waterworks for secondary supply. The fire started in the shipping room on the first floor, and the sprinklers opened and apparently extinguished the fire. Shortly after, however, fire was discovered on the upper floors, and the sprinkler tank having been drained by the first fire, the city pressure was not sufficient to control it. The fire evidently spread through the unprotected vertical openings. The unreliability of unprotected steel in structural work was clearly demonstrated. These unprotected members warped and buckled, pulling in the side walls and completely wrecked the building fifty-five minutes after fire was discovered.

Summary: Deficient water supplies.

S-12154. Department Store. Fire occurred in the upholstering department on the fourth floor from unknown cause. Building was equipped with Niagara-Hibbard sprinklers, supplied by two 4,500-gallon pressure tanks which gave seventy-five pounds pressure top line, and waterworks

which had a pressure of forty-five pounds street grade. There were eight sprinklers in room and all opened, but failed to hold the fire, which burned through roof and would have spread to main building but for a fire wall.

Summary: Cause of failure not determined.

S-11601. Planing Mill and Box Factory. Building was originally brick and equipped with automatic sprinklers supplied by a four-inch connection to city mains. Frame additions to brick buildings were constructed from time to time until they aggregated twice the area of the original brick building. The frame sections were never equipped with sprinklers and many openings into brick section were unprotected. Fire broke out at 7.15 p. m., believed to have been of incendiary origin.

The sprinklers apparently did good work for a time, but in all probability could get no water after the numerous fire engines got into service, having no secondary water supply. The primary supply was city waterworks, which had a static pressure of seventy pounds.

This plant had not been recognized as a sprinklered risk for many years, and very little credit was given for the sprinklers installed.

Loss $80,000 to $90,000.

Summary: Unsprinklered portions.

S-12373. Flour Mill. Plant was equipped many years ago with Clapp sprinklers. System was being standardized and Grinnell heads installed. Work had progressed to some extent, but two lower floors were unprotected at time of fire. Fire originated on first floor from an electrical cause. A large loss resulted.

Summary: Water shut off. Equipment out of service.

S-12069. Woolen Mill. Fire originated in an unsprinklered storehouse and spread rapidly to other unsprinklered buildings. A strong wind carried fire into sprinklered factory, which was located thirty-five to seventy feet from burning buildings. Factory was equipped mostly with Esty heads, supplied by town waterworks and a 3,000-gallon gravity tank. The waterworks pump, which maintained direct pressure, was located in one of the factory buildings and was driven by electric power, current coming from the outside. There was also an electrically driven rotary pump and a small steam pump as auxiliary supplies to the sprinklers.

Before the fire reached the sprinklered building, a pole carrying electric power wires was destroyed; the fuses at the power house blew out and current was shut off. The gravity tank was the only supply and was soon exhausted. The steam pump was started and run for a short while, but with little effect on the fire. A total loss resulted.

Summary: Deficient water supplies.

S-12199. Foundry. Fire occurred in second story (charging floor) of cupola house. Sprinklers in this section were shut off for the winter to prevent freezing, and before men familiar with the system could open valve fire had gained considerable headway and was extinguished by the use of three lines of hose.

Summary: Water shut off.

S-11891. Paper Mill. Fire originated in rag cutter. The water was shut off sprinklers during the re-location of the delivery pipe of the fire pump in the engine room. Work was in progress on the pipe changes when the fire occurred. City water was shut off from sprinklers and yard hydrants. Extra precaution had been taken by laying a length of hose inside, attached to a standpipe, up to the rag-cutting machine. The fire spread so rapidly that this was of no avail. Fire was extinguished by use of outside hose streams from public hydrants. A large loss resulted.

Summary: Water shut off for repairs.

S-12095. Metal Worker. Fire occurred in boiler house, where the sprinklers were shut off during the cold weather. Watchman discovered fire, but forgot to open the valve in engine room which controlled the boiler house sprinklers. He did, however, run out and send in alarm from public box. Department responded and extinguished fire.

Summary: Water shut off in cold weather.

S-12382. Carpet Yarn Mill. Fire occurred in yarn stored in racks, and the obstruction to distribution precluded the possibility of the eighteen sprinklers which operated extinguishing it. Sprinklers were shut off by order of the city department when they arrived, and fire was extinguished by them.

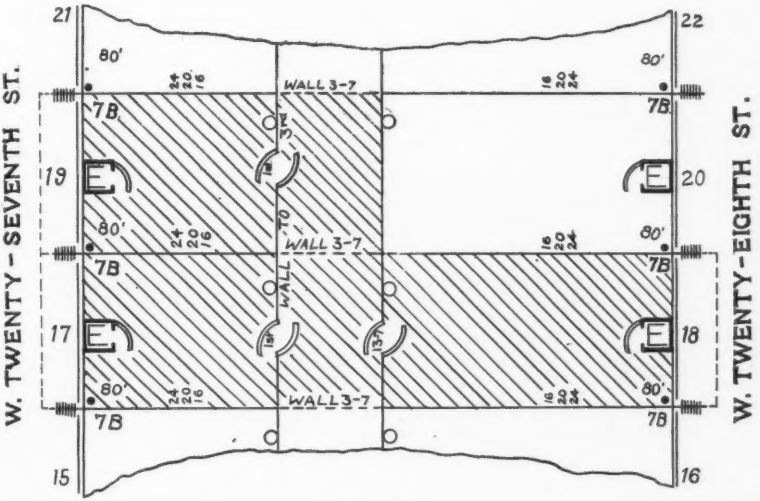
Summary: Obstructions to distribution.

Miscellaneous Fires.

Interesting fires are given under this heading without regard to their classification.

H-7388. January 17, 1912. Terminal Stores Nos. 17, 18 and 19, Brooklyn, N. Y. Construction. Built 1890. Stores 17 and 19 fronting on West 27th Street, adjoining Store 15 on the east and Store 18 fronting on West 28th Street adjoining Store 16 on the east are 7 story and basement ordinary constructed brick buildings. Area 4,750 square feet each in Sections 17 and 19 and 4,900 square feet in Section 18. Parapets 4′ between sections. Floors 2″ on 3 x 14″ joists, 11″ on centers; girders wooden 14 x 16″, supported on first by brick piers and on floors above by wooden posts, three rows in each section, 15½′ on centers; second 24 x 24″, four parts bolted together; third and fourth 14 x 24″, two parts bolted together; fifth 14 x 14″; sixth and seventh 12 x 14″ with iron caps and heel plates. Floor Openings—Stairs in each section provided with automatic wooden traps; elevator in each section in shaft of 4″ tile with sub-standard tin-clad doors to floors. Fire Divisions none between 17 and 19, these sections communicating by unprotected openings; Sections 17 and 18 were separated by 16″ brick wall with communications on all floors above second protected by sub-standard tin-clad fire doors each side of wall. These doors

were covered with 14 x 20″ single lock-jointed tin and were poorly hung to iron track secured over tin-covered wood support. The doors did not lap the opening in a proper manner and there was no sill under doors. Sections 17 and 18 also communicated through railroad tunnel on first floor, which is continuous through Stores 1 to 23. This tunnel forms part of the rear of first and second floors and extends from 11th to 13th Avenues and is



H-7388.

separated from buildings by 16″ brick wall; this tunnel has supporting bolted wrought-iron columns (one row) 15 x 15″, resting upon brick piers 5 x 5′ and metal covered wood girders 14 x 16″. Joists are protected beneath by corrugated iron and the space between same and floor is filled in with mineral wool; at party walls, brick arches are sprung across tunnel. There are communications with tunnel from each section on first by sub-standard tin-clad door on building side and by former standard automatic tin-clad (two-ply) fire doors on tunnel side.

Occupancy. John Wanamaker occupied these buildings as a furniture warehouse with retouching, the fourth floor of No. 17 being used for brass and iron bedstead storage with buffing.

Cause of Fire. On the night of January 16th, employees were loading suburban delivery wagons until 12 o'clock midnight at which time the warehouse was closed and locked. A short time after the employees left the building, the outside watchman detected a smell of smoke and guided by this he reached Store No. 17, and from outside saw a fire burning briskly on first floor. He notified police, who turned in alarm. The fire is thought there-

fore to have started on first floor from smoking by employees engaged in loading furniture.

Spread of Fire. The course of the fire at the start was apparently through the elevator shaft, in front of No. 17. The fire evidently burned through all of No. 17 above the third floor. It also entered No. 19 through unprotected doorways and burned over all floors above the third. One of the fire doors in the division wall between Nos. 17 and 18 seems to have kept the fire from passing through the opening on third floor. The condition of No. 18 indicates that the fire passed through the openings in division wall on fourth and seventh floors. It burned over all floors in this section above the third, with the exception of the sixth. The fire doors, which are badly damaged above the third floor, were found closed on third and sixth and open on fourth and fifth floors. The doors on the seventh floor were destroyed. It is stated that the fire department hoped to save No. 18, and the fire doors, though sub-standard, seem to have kept the fire out of this section for approximately an hour and a half, but finally failed.

How Fought. The fire was extinguished by the public fire department. The buildings were not equipped with automatic sprinklers. The only private appliances consisted of 250′ of 2½″ linen hose on hose carriage and 150′ on reel in tunnel, city connection and pump in Store No. 2. Fire pails and extinguishers were distributed throughout the buildings.

Damage. The roof and all floors above third in Section No. 17 were burned out.

The fire badly damaged No. 19, practically the entire building above the third floor being completely wrecked.

In Section No. 18 all floors above the third, with the exception of the sixth, were practically destroyed.

In addition to the extensive damage by fire in each of the three sections above described, considerable damage was done by water in other sections. The basements were flooded throughout the entire block to a depth ranging from four inches at the east end to the entire depth of basements at the west end. Water apparently seeped through the walls from one basement to another.

Conclusions. The chief points of interest brought out by this fire are as follows:

1st. It is claimed that the presence of iron shutters on all windows facing streets appreciably delayed the discovery of the fire. From this viewpoint, therefore, it would seem that wired glass windows are to be preferred to shutters on all windows facing streets and in fact at all windows where the exposure is not severe.

2d. The fire doors between Sections 17 and 19 were defective, and allowed the fire to pass through them. They were, however, effective for an appreciable time, estimated by some to be considerably more than an hour.

3d. The large amount of water thrown into the three burned sections seeped through the basement walls and did extensive damage to the contents

of the basements in all buildings in the block. The quantity of water was so great that it required several days to pump it out.

S-11713. Furniture Factory. Building in which fire occurred was of good plank and timber construction, plain brick walls and wood columns. Stairs and elevators cut off; hand hoist trapped. At south end of fourth floor against blank section of brick wall was a room about ten feet by fifteen feet, built of light boards on wood studding and lined on inside by lock-jointed tin. There were no hollow spaces. Ceiling also covered by lock-jointed tin, fitting close and following contour of ceiling.

One doorway to room had door of double boards covered on inside by lock-jointed tin. Floor covered with tin. Room contained one barrel of wood alcohol, two barrels of mahogany stain, three barrels of shellac, one drum of crude oil, one drum of linseed oil, one drum of floor dressing, one of pigment filler, small stock of lampblack in small packages, and few paper cuspidors and sheets of sandpaper. Spigot in barrel of stain leaked and stain ran on floor across room and under door.

Stain was bought ready mixed in barrels and was thined with some inflammable volatile. On his 10 p. m. round the watchman noticed a liquid on floor in front of door to oil vault. He thought something had been spilled, so wiped it up. Door to room was kept locked. On his 11 o'clock round he noticed more on floor, and after finishing his round, about 11.30, he went back to oil vault to see what was the trouble. He stood his lantern on floor, about two feet from door to vault, and started to wipe floor. In a moment there was a flash of flame, as the vapor became ignited by the lantern; and watchman was driven out. He ran downstairs and out to corner to pull fire alarm box. He said sprinkler alarm was ringing when he reached the box. Rushing in again, he raked boiler fires and regulated fire pump. The pump was working automatically at seventy-five pounds. This pump was a 750-gallon Ludlow duplex steam pump, controlled by Fisher regulator.

The four sprinklers in oil vault opened and also one in main room just outside door. These five sprinklers extinguished fire. Pressure on these heads about sixty-five pounds. Firemen arrived and used chemical extinguisher and cut a couple of unncessary holes in wall and top of oil vault. Otherwise there was practically no damage to building. Water flowed all over floor and seeped through to lower floors, doing considerable damage to finished stock.

Oils, paints, varnishes, etc., when kept inside of buildings, should be stored only in rooms built according to the specifications for the construction of inside oil rooms.

S-11712. Tenant Woodworker. An earlier fire occurred at risk which was practically extinguished by the sprinklers, and the fire department left at 11.30 p. m. without leaving anyone on watch. A policeman discovered smoke issuing from an elevator pent house on roof and sent in an alarm at 6.35 a. m. The fire gained sufficient headway to enter several floors by means of the wood-enclosed elevator shaft, and 120 sprinklers in all operated.

Fire very forcibly showed the danger of leaving premises unguarded directly after a fire has apparently been completely extinguished.

H-6911. Public Gasolene Station. Occupancy Selling Gasolene and Oil to Automobile Trade.

H-6911

The building was a small frame shed. It contained a sub-standard oil storage installation. There was a tank of Bowser system, No. 41, buried underground beneath the shed. The filler vent was inside the shed. There were also five jigger pump tanks which contained lubricating oil. The oil room was not in best condition and oil was allowed to drip on floor. The Standard Oil Company's delivery wagon had just made a delivery of gasolene. A helper standing on the sidewalk struck a match to light a cigarette. A part of the head flew off and lighted the gasolene in the drip pan beside the gasolene pump. Fire immediately ensued, but no explosion occurred. Fire department responded and fought the fire with chemicals and water. The accompanying cut shows the condition of the shed after the fire was extinguished. The pump marked "X" was the one in use at the time of fire and the other pump shown was shut off in another room.

The following recommendations were offered: No smoking to be allowed on sidewalk adjacent to such public stations; fiiller vent to be on outside of building at curb line; oils to be kept in separate rooms and not allowed to drip on floors.

S-11736. Machine Shop. The part of the room in which fire occurred was used for storage of blueprints. The prints were filed on shelves in wooden cases, and were prints which had been sent in by purchasers for whom the mill had made working drawings. The door to this room was kept locked, as it also contained catalogues and some office supplies. There was a window between this room and the blueprint room, and employee at work in this latter room first saw the fire. He immediately notified others of the office force and a public alarm was given.

An attempt was made to extinguish the fire with chemical extinguishers, but as this was not successful, one large stream was taken upstairs by the public department, and the fire extinguished in a very few minutes. There was some damage to the wooden cases and to the windows which were broken out to clear the room of smoke. The principal damage was to the ceilings and walls in the floors below by water. On account of the hollow floors the water spread out and leaked through into several of the rooms, so that it was necessary to have the ceilings and walls repainted.

About fifteen minutes before the fire was discovered a boy had been sent to this room for one of the blueprints, and it is surmised that fire was due to smoking.

S-11756. Metal Worker. On the second floor, where fire occurred, there was a brick heater used in connection with a galvanizing process carried on in the floor above. The fire box was in the second floor and coke was used for fuel. The wooden floor near the fire box door was taken up and four inches of concrete laid. In addition to this, an iron fender in the shape of a half circle stood on the concrete and against the brickwork of the heater. This was done to keep hot charcoal which might drop out of the door within in a small space on the concrete floor. About 1.30 a. m., while on his rounds, the watchman saw smoke coming up around a post and at one or two other points. He notified the superintendent, who instructed him to remain there until he arrived. After removing some of the wooden flooring, they decided that the fire was under the concrete. On removing the concrete, the fire flashed up, but was extinguished in about ten minutes with hose streams and pails of water. About one and one-half inches from the heater, in the hollow space, was a wooden beam eleven inches by sixteen inches, and this was badly charred on the upper side. The probable cause of the fire was that hot coke, falling on the concrete and being confined to a small space, gradually heated the beam directly under it until it ignited. This smouldering fire had undoubtedly been burning for several days, as shown by the condition of the timber.

H-6566. June 30, 1911. Planing Mill and Lumber Yard. Planing mill was a one-story, open finish wooden building with composition roof and floors of heavy matched boards on joists with heavy wooden posts. Area, 100 by 125 feet. Planing mill communicated with large, open fin-

ished frame lumber sheds and by raised platforms and lumber yard with all parts of yard. Small outbuildings, including office and stable, were of ordinary frame construction, located across the street. Occupancy was usual to this class, with the exception of an iron refuse burner located in yard, the arrangement of which was considered standard. Only hard refuse was burned, the soft wood refuse being baled and sold. The burner was about twelve feet in diameter and fifty feet high, lined with brick to a height of twenty feet, and had no openings except where refuse conveyor entered and at the grate. The burner was provided with an approved spark screen at the top. During an inspection of this mill it was noted that the grate door of this burner was open and that the draught was down, causing sparks to fly out into the lumber piles, a few feet away. The door was immediately closed, and members of the firm notified at once. A strict injunction was given the foreman not to permit this door to be opened by any of the employees, and it was a presumption that the order was not heeded.

The fire was discovered by one of the employees at about 2.15 p. m. An alarm was turned in. This communicated to all the private fire stations at plant, including the pump house.

The available hose in the mill building, and casks and pails on platforms and elsewhere, were brought into use by employees at once, but the fire spread rapidly, and the water in barrels was soon exhausted. The water pressure at the hose outlet was very poor, and no effectual stream could be had. The employees were afterward driven from the scene by intense heat, leaving the two two and one-half inch outlets on risers open. The fire department was prompt to arrive and prompt in making connections and in their work. A total of eleven hose lines were put into service, and the actual pressure shown on the private gauge at nearby factory was seven pounds. As the magnitude of the fire increased, all garden hose, buckets, etc., were brought into play by private citizens to protect their own homes from the fire brands, thus taxing the mains to their utmost capacity.

There are but 15,300 feet of ten-inch, and 2,500 feet of eight-inch pipe in the entire system of some 28 miles of pipe, and these, exclusive of the short main feeders, are required to distribute to 250 double hydrants and about 2,700 private services.

Property was under full city protection of paid municipal fire department. Nearest fire department house was four blocks distant. Fire alarm box across street. Two double hydrants on six-inch mains across street. Other hydrants on ten, four and six inch mains available.

Some days after the fire a test was made at the location of this fire to determine the actual pressure, under the same conditions as nearly as possible. With eleven hose streams on the pressure averaged twelve pounds. By this we must consider that two two and one-half inch hose outlets left open in the planing mill and innumerable hose streams of private parties were not draining upon the system, so that the pressure of seven pounds taken on the private gauge was probably fairly correct. The point where

the fire occurred was about two and one-quarter miles from the pumping station.

An examination of the card taken from the recording pressure gauge, located at the pump house, shows that the following pressures were recorded at the time of the fire; viz., 2.15 p. m., 50 pounds; 2.20 p. m., 90 pounds; 3 p. m. to 3.30 p. m., 105 pounds; 4 p. m., 90 pounds; 4 p. m. to 10 p. m., 85 to 90 pounds; and from 60 to 70 pounds thereafter. The conclusion is, therefore, that the distributing system was excessively weak, and that no satisfactory pressure could be attained at a considerable distance from the pumping station. This condition virtually affects all of the manufacturing district, and especially the south end of the town and the high lumber values along the river bank, which are not readily accessible on account of railroad tracks intervening, and having not larger than a six-inch main in any instance.

Total loss on buildings, $21,000; on contents, $123,000.

The prevailing temperature at time of fire was about 85 degrees, and this temperature had been continuous for some time past. There was practically no breeze at the time of fire, and this fact accounts for the results not being worse than they were.

Lesson: This fire exemplifies the need of a strong distributing system in factory or congested districts, especially where such districts are of a combustible nature and not equipped with sufficient automatic protection. The lack of ample sized water mains is especially important where a public fire department depends wholly on direct pressure.

The cause of the fire points out that refuse burners should be separated from lumber yards and woodworkers by ample clear space; and if a clear space cannot be maintained, some means of keeping grate doors closed should be devised.

S-11730. Cotton Mill. A slight accident on napping machine tore off a piece of cloth which went through dust exhaust flue and wound around fan shaft. This became heated by friction and set fire to dust room. The napping lint was so quickly ignited as to form a slight explosion and fire was communicated to the napping room above through several neglected small holes in the floor where one to one and one-half inch pipes had been removed, also at points where narrow cracks in the floor had appeared. In the napping room, the fire spread over the floor and to several loads of cloth in process.

Ten sprinklers opened in the napping room, three in the dust collecting duct, and sixteen in the dust room. With the assistance of large hose streams from outside, the fire was extinguished in about an hour. Water slightly damaged the clothing on several nappers, and wet cloth not touched by fire.

Lessons: The importance of complete cut-off between dust room and manufacturing rooms.

Fireproofing the ceiling of dust room with expanded metal and cement plaster will prevent damage to building on similar occasions.

Fire Causes.

The fires here given are selected to illustrate defects, either of construction or superintendence, in the classes of property indicated.

Boiler.

H-7061. Saw Mill. Sparks from Dutch oven ignited hot ceiling or dust on ceiling over boiler furnace.

H-7208. Electric Light and Ice Plant. Accumulated dust on top of boiler ignited and set fire to ceiling which was only twenty inches above top of boiler. Two previous fires were caused in similar manner.

Tops of boilers should be kept entirely free of dust and other accumulations.

Careless Workmen.

H-7335. Fertilizer Factory. Plumber's Torch. Torch left by employee who was thawing out pipes.

H-7188. Wagon Factory. Lighted Candle. Fire due to careless use of lighted candle by plumber who was repairing water pipes.

H-7101. Fine Residence. Painter's Torch. Painter used a torch to burn off varnish on wood paneling in dining room. Space between paneling and studding was packed with material of inflammable nature which was ignited by the torch.

These are typical examples of everyday occurrences due to the inborn careless habits of the American people and the irresponsibility of some of her workers.

Chimneys.

H-7314. Mercantile. Usual heating plant out of use and temporary heat was being furnished by a seldom-used fireplace. Fire worked through the chimney and set fire to partitions.

Great care should be taken to carefully inspect chimneys that communicate with fireplaces that are seldom used.

H-7466. Machine Shop. Stove pipe from stove in first floor passed through second floor and roof. A brisk fire was built which was more than rusty pipe could stand, and pattern storage in second floor was ignited.

Stove pipes should never pass through floors and roofs, but should enter a well-constructed chimney.

S-12150. Weaving Mill. Fire was caused by metal stack from a vertical boiler. There was no clearance between stack and roof members, and the heat from the stack ignited the roof.

Iron smokestacks, where passing through roofs, should be protected in some such manner as was suggested in the October Quarterly (1911), page 157.

Coal. Spontaneous Ignition.

S-12143. Woolen Mill. About thirty-five tons of Pocahontas soft coal was stored in coal room. When fire was discovered coal was giving off smoke and gas, and interior of pile was glowing.

H-7062. Machine Shop. Fire broke out in soft coal located in an open top frame coal bin, containing 800 to 900 tons of coal piled not over twenty feet high.

H-7096. Tenant Building. Spontaneous ignition of soft slack coal stored in basement started a slow combustion which generated an inflammable and explosive coal gas that set fire to building. Night watchman telephoned for fire department. He was found dead in the basement on their arrival.

Large amounts of soft coal should not be stored inside of main buildings, and large outside piles should be carefully watched to guard against spontaneous ignition.

Gas Pipes.

H-7325. Restaurant. Defective gas pipe under building allowed gas to escape and collect. A careless smoker threw lighted match onto floor near wall and an explosion occurred.

Illuminating gas is heavier than air, and if it escapes it is apt to collect in basements and concealed places. Great care should be exercised if its presence is suspected.

Gasolene.

H-7246. Garage. An employee was under a car cleaning the motor with a small can of gasolene, and he had a portable incandescent lamp. The lamp fell on cement floor, broke, and ignited the gasolene vapor.

H-7511. Garage. Employee was using a gasolene blowpipe to remove grease from machine. This filled the rooms with fumes and saturated his clothes with oil. He went to a stove to warm himself and his clothes ignited. An explosion followed and man was blown through a window. He died a few hours afterwards.

Such accidents seem incredible to thinking people, but equally thoughtless acts are of daily occurrence.

Heating.

H-7295. Mercantile. Pipes from furnace located too near to woodwork, and were not protected. Furnace became overheated while burning up old boxes and trash.

H-7181. Woodworker. Overheated and unprotected boiler set fire to frame partition to which it was very close.

H-7148. Mercantile. Rubber tube gas connection to small stove in show window became overheated and ignited.

Rubber tubes should never be allowed on gas stoves.

S-12092. Furniture Factory. Steam heating pipes, carrying live steam under about sixty pounds pressure, ignited shavings which had accumulated around pipes under a bench.

S-12042. Printery. Fire occurred on an extremely cold day in a pile of paper piled against steam pipes.

There is no excuse for the above two fires. The ordinary rules of cleanliness and precaution should preclude the possibility of such needless waste.

S-12036. Printery. Gas stove which was left burning all night set fire to floor.

A master valve should control the gas supply and this should be regularly closed at night by some responsible person.

Lighting.

H-7318. Printery. Short circuit in defective electric light socket ignited drop cord, which set fire to wooden ceiling above.

S-12085. Jewelry Store. Large inverted Welsbach gas burner left burning with air supply shut off. This caused mantle to carbonize and break, particles dropping red hot on floor and setting fire to same.

S-12082. Department Store. Electric lights went out and candles were lighted and passed about from one person to another. One came in contact with some feather boas, and these were ignited.

S-12052. Rendering Works. Custom of watchman to hang a kerosene oil lantern near water gage on boiler so that he could readily see height of water in boiler. This lantern exploded while watchman was in the plant making his rounds.

S-12060. Paper Mill. Careless use of kerosene oil lamp by watchman. Used for light in boiler room while washing, and either left burning in contact with woodwork or knocked off from wooden steps on which it was placed.

S-12062. Chair Factory. Fumes from staining liquid in chair dip tank were ignited by flame of watchman's lantern when he attempted to stain a fish pole.

The above three fires inspire misgivings as to the advisibility of watchmen being provided with any light. These fires, due to the "Watchman hazard," may shed some light on many unknown fires.

S-11357. Automobile Factory. A "Prestolite" gas tank leaked slightly and watchman's lantern ignited the gas, causing a slight explosion.

S-12140. Fruit Products Factory. Insulation on drop cord for electric light worn off by coming in contact with piping. A short circuit was caused, which ignited some packing material.

S-12167. Rubber Works. A Fisher billing machine was fitted with a small electric light to enable the operator to see the work under the machine. The wiring became short circuited through the machine. Rubber parts were burned, and machine warped beyond repair.

H-7470. Storehouse. A carpenter employed to make ordinary repairs found it necessary to use a lantern and two candles, which he placed on the floor. When leaving, he took lantern but forgot the candles, which ignited flooring.

Locomotive Sparks.

H-7382. Metal Worker. Sparks from switching engine lodged in under moulding of cornice and burned into hollow space within, finding there sufficient air to burst into flames.

Hollow cornices should be removed or sheathed with tin.

H-7275. Straw Board Factory. Pile of baled strawboard in yard ignited by sparks from switching engine.

Matches.

H-7198. Wholesale Grocery. Started in center of building where a carload of matches was stored.

H-7185. Knitting Mill. Careless disposal of lighted match by an employee while leaving. Thrown into packing box containing sweepings.

S-11609. Cotton Mill. Truck containing a bale of waste ran over a match on floor near a pile of loose cotton.

S-12032. Electrical Appliances. Match accidentally dropped by employee onto hot wax.

S-12463. Cotton Mill. This was the second large fire at this mill caused by matches on the floor.

After this experience, the mill owners made most stringent rules against the bringing of matches within fifty feet of the mill, and against smoking within this limit.

H-7487. Laundry. Fire started in a bundle of laundry containing white waiters' jackets, supposedly from matches in a pocket of one of these.

Oily Material. Spontaneous Ignition.

S-12059. Mercantile. Linseed oil had been used to oil floor. About two weeks thereafter a mop which had been used to clean with was placed under a counter which was directly over the boiler in basement. Spontaneous ignition resulted.

S–12075. Mercury Vapor Lamp Factory. Painter in paint shop had allowed the paint rags to accumulate on the floor, instead of removing them and burning them each evening. Spontaneous ignition of these rags caused fire.

Power.

H–7454. Woodworking Plant. Main shafting supplying power to the building in which fire occurred ran in low vacant space under building, which was more or less filled with shavings and dust. A hot bearing ignited this accumulation.

Shaft bearing should never be run in places where it cannot be easily oiled and cared for. This is of especial importance in woodworkers where inflammable dust and shavings may collect.

Rubbish and Sweepings.

H–7321. Jewelry Factory. Rubbish piled too near heating plant.

S–11978. Cigar Factory. Fire originated in a wooden box which contained Rubbish.

Rubbish and sweepings should be placed in metal barrels and burned daily.

S–12147. Tenant Manufacturing. Fire caused by spontaneous ignition of sweepings and oily waste in a metal can with defective bottom. A wooden top flooring and a frame partition were ignited.

Only approved waste cans should be used.

Smoking.

H–7319. Metal Worker. Watchman ate his lunch in boiler room. No fire under boilers, but a pile of refuse from pattern room in front of boiler ready for use in kindling fire in morning. Supposed that watchman threw a match or cigar stub into this pile. Plant nearly destroyed.

S–12023. Shirt Factory. Employee threw lighted cigarette into sawdust spittoon.

Points of Interest from Fire Reports.

These notes are intended to illustrate the efficiency or inefficiency of signaling, retardant or extinguishing agencies.

Alarm Service.

S-11978. Cigar Factory. Sprinkler alarm valve connected to electric bell in factory and one in dwelling of superintendent. No watchman maintained. Sprinklers apparently operated about twenty-five minutes before the alarm in dwelling was effective.

Alarm valves should be provided with outside rotary gongs and connected to approved central station.

S-12090. Warehouse. Water flow signal received at central station and runner dispatched. Outside rotary gong operated and notified policeman before runner got to building, and alarm was sent in. Fire was extinguished and water shut off six minutes after first notification was received.

S-12076. Tenant Manufacturing. Thermostats used were high test. Sprinklers operated first and prevented other thermostats from operating.

H-6839. Fur Hat Factory. Watchman's service nights and Sundays. Fire occurred on Saturday afternoon while plant was shut down for usual half holiday, and gained too great a headway to be controlled, owing to its tardy discovery.

Emphasizes need of watchman's service on Saturday half holidays as well as at all other times when not operating.

S-12394. Tenant Manufacturing. Fire discovered by last employee to leave the building. He rushed out to send in fire alarm and found, on his return, that one sprinkler had operated and held the fire. Building had no watchman's service and the dry valve which controlled sprinkler system had no alarm attachment. A large water damage was narrowly averted by this chance discovery.

This fire emphasizes the necessity of equipping all sprinkler systems with automatic alarm devices.

Automatic Sprinklers.

Failure.

S-12042. Printery. One head which was directly above fire did not operate, while the head which operated was eight feet away. The heads were located under open joist construction.

Shows the undesirable effect of drafts upon the operation of sprinklers when placed under joist construction.

Unsprinklered Portions.

S-12104. Telephone Booth. Fire originated inside of telephone booth. Three heads in main room operated and extinguished fire, but did considerable water damage.

Shows the need of placing a sprinkler inside of telephone booths.

S-12081. Carriage Works. Fire originated in boiler room and entered shavings vault. The latter was not equipped with sprinklers and the fire required public fire department to extinguish.

All portions of a plant, especially hazardous rooms such as shavings vaults, should always be equipped with sprinklers.

S-12089. Worsted Mill. Fire originated in unsprinklered dye house and spread to main mill, opening seventy-four heads.

Emphasized the danger of unsprinklered sections. Had the dye house been sprinklered, the fire could probably have been confined to it with only a partial loss, the resulting heavy water loss in the main mill would have been avoided, and smoke damage there very greatly reduced.

Water Shut Off Too Soon.

S-12480. Carpet Mill. Fire discovered in a small room on fifth floor into which a picker discharged. One sprinkler was in operation and had practically extinguished the fire when discovered. Employees used a few pails of water, then went downstairs and shut off the sprinklers. When they got back the fire had broken out again. Probably four or five minutes elapsed from the time water was shut off until it was turned on again, and eleven heads opened before the second fire was subdued.

Never leave the scene of a fire without a watchman until complete extinguishment is certain. Never shut off the sprinklers until sure that the fire is under control.

Construction.

S-12247. Woolen Mill. Considerable difficulty was found in extinguishing the fire because of the poor construction of the roof. This was an ordinary joist constructed roof with tin on the outside and lined with corrugated iron inside. The fire entered through the cracks of the corrugated iron and spread through the concealed space, making it necessary to tear off practically one-half of the roof of the building to extinguish it.

Cut-offs.

H-7297. Furniture Warehouse. Buildings were of brick and wood construction, separated by double standard fire doors. Fire originated in frame portion, which was destroyed, but the fire doors successfully kept the fire from entering the brick building.

This clearly demonstrated the efficiency of standard construction and approved devices.

Exposure.

H-7226. Toy Manufacturing. Fire destroyed an adjacent exposing theatre. A twelve-inch brick wall separated this building from the exposing theatre. The wall was blank at first story but in the two other floors there were windows unprotected at top story above stage of theatre, and windows that were boarded up in second and third floors at back of stage. The fire readily spread through these unprotected windows into this building and a heavy loss resulted.

This fire clearly shows the necessity for adequate protection against exposure.

H-7193. Printery. Walls of adjacent building were brick and blank with exception of two openings protected by tin-covered shutters. Shutters prevented fire from spreading into building at that point.

S-12111. Shoddy Mill. About twelve feet from mill there was a three-story brick factory with exposed windows protected by open sprinklers. The watchman in that building promptly turned on the open sprinklers and they kept the fire from entering, only a few panes of glass being broken by the heat.

S-12133. Dry Goods Store. Fire in exposing building with a twelve-foot alley between. Heat was intense. Building protected by practically standard wired glass windows in metal frames. Two fires originated in building due to heat radiation. Extinguished by sprinklers.

Floor Openings.

H-7193. Printery. Tin-clad doors on elevator shaft prevented fire from spreading in that direction.

H-7096. Tailoring Establishment. Fire was confined to basement where it originated, until arrival of fire department, due to the fact that the stairway was enclosed.

These two fires demonstrate the utility and value of proper treatment of floor openings.

S-12246. Knitting Mill. At some previous time, two small pipes which took the waste from the finisher card to the picker room below had been removed, and the holes through the floor had not been closed up. A fire occurred at the card, and burning material dropped through hole into picker room.

H-7437. Furniture Factory. Fire started in basement, but rapidly enveloped the whole building by spreading through the open elevator shaft.

These two fires demonstrate the futility of fire protection when fundamental rules of construction are disregarded.

Management.

S-11929. Mercantile. During an apparently needless delay between the completion of sprinkler equipment and connection with the water company, building took fire and burned.

Protection Inside.

H-7246. Garage. Ignition of gasolene vapor set fire to automobile. It was stated that both a regular two and one-half gallon chemical extinguisher and a quart extinguisher were used on the fire with but little effect. Two automobiles were destroyed.

S-12096. Cop Yarn Knitting Mill. Fire, caused by electric press irons, was extinguished with two pails of water before sprinklers had time to operate. Considerable loss from water damage was in this manner averted.

S-12088. Yarn Mill. Fire extinguished in cards by chemical extinguishers before sprinklers had a chance to operate.

Pails and chemical extinguishers should always be provided in accordance with the requirements of the local underwriters.

Protection Outside.

H-7332. Woolen Mill. Fire pump and wheel should have been arranged to start from outside. Delay in starting these caused loss of factory.

Use of Too Much Water.

S-12214. Bleachery. Two sprinklers opened and held fire. Two lines of hose used by mill fire brigade. About 300 pieces of sateens on the floor near origin of fire were wet down and had to be refinished.

Probably less damage would have resulted if the large hose streams had not been used, as the sprinklers would have controlled the fire well.

S-12236. Storage Warehouse. Contained sisal, hemp and Istle in bales. Fire occurred in centre of room. When sprinklers were shut off, the fire was practically extinguished and had done very little damage. Four hose streams were used from the doorway on account of the smoke. Considerable of the hemp between doorway and seat of fire was wet and it is doubtful if much or any of the water from the hose reached the fire.

Annual Summary.

Statistics of Fires in Properties Having Automatic Sprinkler Protection.

NOTE.—These tabulations are made at the close of each fiscal year, with the object of furnishing a basis upon which the virtue of the automatic sprinkler as an extinguishing agent can be estimated.

Section I is devoted to fires in which the behavior of sprinklers was, for the reasons given, unsatisfactory.

Section II is a statistical record of all reports of sprinkler fires in the files of the Association upon which the information obtained is sufficiently complete for statistical purposes.

In each table the results of the current year ending April 1, 1912, are given, and these are compared to the results of the total sixteen-year record ending at this time.

This is the fifth year that our annual statistics have been presented in substantially the present form. We can now make certain studies and deductions concerning the operation and effect of automatic sprinklers of considerable interest and value.

During this period there has been a gradual decrease in the number of sprinkler failures. The first annual tables prepared, of all fire records available, showed that 6.23 per cent resulted in failure. The failures have held at about five per cent the last two years. A study of the causes of these failures suggests that we can hardly hope for a material reduction in this percentage during the next few years. The summary of these failures each year shows almost identically the same relative percentage of failures for each specified cause as those in the present summary. Nearly one-fourth of these failures are due to the fact that the water was shut off from the system, and nearly three-fourths of the latter cases are due to the "man-hazard," which must always be a factor to be reckoned with.

There has been a constant increase in the total number of fires held in check by the sprinklers. Five years ago this percentage was 27.16, while the present summary shows the percentage to be 31.37. There has been a very slight decrease in the number of fires practically or entirely extinguished.

The percentage of fires extinguished by the operation of various number of sprinklers shows a remarkable unanimity. The percentages have varied so slightly during the periods which have been recorded, that it may almost be stated as a law that, for instance, 30 per cent of all sprinkler fires will be satisfactorily extinguished or held in check by the operation of one head. An equally amazing regularity of agreement extends throughout the percentages of total numbers of sprinklers operating, as for instance, that 66 per cent of all fires can be expected to be extinguished by the operation of not over five heads, and that 80 per cent will be extinguished by ten heads or less.

SECTION I.

Summary of Unsatisfactory Sprinkler Fires.

	1911-1912.		1897-1912 Inc.	
	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.
Water shut off sprinklers	8	17	136	22
Generally defective equipment and unsprinklered portions	11	23	142	23
Defective water supply or supplies	7	15	70	12
Exposure or conflagration	5	11	60	10
Hazard of occupancy too severe for average sprinkler equipment	1	2	34	6
Obstruction to distribution	1	2	30	5
Faulty building construction, concealed space, vertical openings, etc.	3	6	28	4.5
Explosion crippled sprinkler system	1	2	24	4
Sprinkler system crippled due to freezing	1	2	16	2.5
Slow operation of dry system or defective dry valve	3	6	15	2.5
Slow or defective operation of high test heads	..	..	9	1.5
Miscellaneous. Plugged Heads	2	4	21	3
Not classified	4	9	24	4
Total	47		609	

Special Classification of Fires in which Failure was Due to Water Being Shut Off Sprinklers.

	1911-1912. No. of Fires.	1897-1912 Inc. No. of Fires.
Water shut off for unknown reason, neglect or carelessness	2	57
Water shut off before fire was out or fire re-kindled	2	25
Water shut off due to accident or repairs	1	20
Water shut off to prevent freezing	3	19
Water shut off, probably incendiary	..	7
Water shut off, leaky dry system	..	3
Water shut off, miscellaneous	..	3
Water shut off, defective gate valve	..	2
Total water shut off sprinklers	8	136

SECTION II.

Annual Revision of Sprinkler Fire Tables.

In the following ten tables is given a summary of fires occurring in properties equipped with sprinklers. Number of fires reported during year, 923, not including 327 fires where no sprinklers were opened. Total number of fires on record for years 1897 to 1912, 10,356, being a sixteen years' record.

These tables constitute a complete up-to-date revision of similar tables previously published. In addition to the fires, of which a complete record has been obtained, and which are indexed, many reports were received in the past on fires of which the record was incomplete. Such fires were used in some of the tables but not in others, and are not included in the above total.

Table No. 1.

Time of Day.

	No. of Fires. 1911-1912.	No. of Fires. 1897-1912 Inc.	Per cent of No. with Data Given. 1911-1912.	Per cent of No. with Data Given. 1897-1912 Inc
6 a. m. to 6 p. m.	508	5889	56	58
6 p. m. to 6 a. m.	407	4206	44	42
Total with data given	915	10095		
No data	8	261		
Total	923	10356		

Table No. 2.

How Discovered.

	No. of Fires. 1911-1912.	No. of Fires. 1897-1912 Inc.	Per cent of No. with Data Given. 1911-1912.	Per cent of No. with Data Given. 1897-1912 Inc.
Employee	509	6145	55.7	61.6
Watchman	163	1593	17.8	16.0
Sprinkler Alarm	148	1276	16.2	12.8
Outsider	43	529	4.7	5.3
Thermostats	35	385	3.8	3.9
Automatic Pump	..	9	..	.1
Supervisory System	16	34	1.8	.3
Total with data given	914	9971		
No data	9	385		
Total	923	10356		

Table No. 3.

Efficiency of Alarm Service, 1911-1912.

	Satisfactory.		Failure.		Total.
	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	
Watchman alone	56	92	5	8	61
Sprinkler alarm alone	68	93	5	7	73
Thermostats alone	7	70	3	30	10

	Watchman.		Sprinkler Alarm.		Thermostat.		Supervisory.		Total.
	Satisfactory.	Failure.	Satisfactory.	Failure.	Satisfactory.	Failure.	Satisfactory.	Failure.	
Watchman and Sprinkler Alarm	134	35*	156	13	..	..	..	..	169
Watchman and Thermostats	4	1*	..	..	5	..	..	..	5
Sprinkler Alarm and Thermostats	..	..	29	2	26	5	..	..	31
Watchman, Sprinkler Alarm and Thermostats	3	2*	5	..	4	1	..	..	5
Sprinkler Alarm and Supervisory System	..	..	16	..	..	..	16	..	16
Watchman and Supervisory	1	..	..	..	..	..	1	..	1
Watchman, Sprinkler Alarm and Supervisory	12	2*	14	..	..	..	14	..	14
Thermostats, Sprinkler Alarm and Supervisory	..	..	3	..	2	1	3	..	3

Efficiency of Alarm Service, 1897-1912, Inclusive.

	Satisfactory.		Failure.		Total.
	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	
Watchman alone	907	90	95	10	1002
Sprinkler alarm alone	778	93	62	7	840
Thermostats alone	149	79	40	21	189

	Watchman.		Sprinkler Alarm.		Thermostat.		Supervisory.		Total.
	Satisfactory.	Failure.	Satisfactory.	Failure.	Satisfactory.	Failure.	Satisfactory.	Failure.	
Watchman and Sprinkler Alarm	683	351*	896	138	..	..	..	..	1034
Watchman and Thermostats	11	4*	..	..	14	1	..	..	15
Sprinkler Alarm and Thermostats	..	..	300	24	242	82	..	..	324
Watchman, Sprinkler Alarm and Thermostats	31	38*	62	7	50	19	..	..	69
Watchman and Supervisory	1	..	..	..	..	..	1	..	1
Sprinkler Alarm and Supervisory System	..	..	30	..	..	..	30	..	30
Thermostats, Sprinkler Alarm and Supervisory System	..	..	5	..	4	1	5	..	5
Watchman, Sprinkler Alarm and Supervisory System	20	9*	29	..	..	..	29	..	29

*These include fires where sprinkler alarm or thermostats notified the watchman.

Note.— These tables do not include fires where alarm service does or does not operate promptly if fire is at once discovered by employee, the alarm service having no bearing on such fires one way or the other.

Table No. 4.

Number of Sprinklers Operating.

No. of Sprinklers Operating	No. of Fires. 1911-1912.	No. of Fires. 1897-1912 Inc.	Per Cent. of Whole. 1911-1912.	Per Cent. of Whole. 1897-1912 Inc.
1	286	3572	31.6	30.1
2	147	1868	16.3	15.8
3	77	1216	8.5	10.3
4	72	875	7.9	7.4
5	38	586	4.2	5.0
6	42	488	4.6	4.1
7	25	323	2.8	2.7
8	21	314	2.3	2.6
9	19	208	2.1	1.8
10	12	194	1.3	1.6
11	7	163	0.8	1.4
12	12	175	1.3	1.5
13	8	105	0.9	0.9
14	9	120	1.0	1.0
15	6	92	0.6	0.8
16 to 20	23	337	2.5	2.8
21 to 25	22	212	2.4	1.8
26 to 30	14	155	1.6	1.3
31 to 35	9	88	1.0	0.7
36 to 40	7	75	0.8	0.6
41 to 50	5	112	0.5	0.9
51 to 75	14	156	1.6	1.3
76 to 100	7	77	0.8	0.6
Over 100 (including large number or all)	24	364	2.6	3.0
Total with data given	906	11875		
Water shut off sprinklers	3	107		
No data	14	198		
Total	923	12180		

Table No. 5.

Number of Sprinklers Operating.

No. of Sprinklers Operating	No. of Fires. 1897-1912 Inc.	Per Cent. of Whole 1897-1912 Inc.
1	3575	30.0
2 or less	5440	45.8
3 or less	6656	56.0
4 or less	7531	63.4
5 or less	8117	68.4
6 or less	8605	72.5
7 or less	8928	75.2
8 or less	9242	77.8
9 or less	9450	79.6
10 or less	9644	81.2
11 or less	9807	82.6
12 or less	9982	83.2

Table No. 5—Continued.

Number of Sprinklers Operating.

No. of Sprinklers Operating	No. of Fires, 1897-1911 Inc.	Per Cent. of Whole 1897-1911 Inc.
13 or less	10087	84.1
14 or less	10207	85.9
15 or less	10299	86.7
20 or less	10636	89.6
25 or less	10848	91.4
30 or less	11003	92.7
35 or less	11091	93.4
40 or less	11166	94.0
50 or less	11278	95.0
75 or less	11434	96.2
100 or less	11511	96.9
Over 100 (including large number or all)	364	3.1
Total with data given	11875	
Water shut off sprinklers	107	
No data	198	
Total	12180	

Table No. 6.

Sprinklers Opened on Wet or Dry Systems.

	No. of Fires, 1911-1912.	No. of Fires, 1897-1912 Inc.	Per Cent. of No. with Data Given, 1911-1912.	Per Cent. of No. with Data Given, 1897-1912 Inc.
Wet system	677	7878	74	79
Dry system	237	2101	26	21
Total with data given	914	9979		
Water shut off system	2	106		
No data	7	271		
Total	923	10356		

Table No. 7.

Primary Water Supplies to Sprinklers Opened.

	No. of Fires, 1911-1912.	No. of Fires, 1897-1912 Inc.	Per Cent. of No. with Data Given, 1911-1912.	Per Cent. of No. with Data Given, 1897-1912 Inc.
Water Works	524	4924	58	49.5
Gravity Tank	196	3008	21	30.0
Pressure Tank	147	1444	16	14.5
Automatic Pump	43	594	5	6.0
Automatic Electric Pump	..	1	..	.01
Steamer Connection	..	1	..	.01
Total with data given	910	9972		
Water shut off system	3	107		
No data	10	277		
Total	923	10356		

Table No. 8.

Effect of Sprinklers.

	No. of Fires. 1911-1912.	No. of Fires. 1897-1912 Inc.	Per Cent. of No. with Data Given. 1911-1912.	Per Cent. of No. with Data Given. 1897-1912 Inc.
Practically or entirely extinguished fire	569	7750	61.65	63.63
Held fire in check	307	3821	33.26	31.37
Total successful	876	11571	94.91	95.00
Unsatisfactory	47	609	5.09	5.00
Total	923	12180		

Table No. 9.

Showing Effect of Sprinklers by Class of Occupancy.

	Extinguished Fire.		Held Fire in Check.		Total Satisfactory.		Unsatisfactory.		Total No. of Fires.
	No.	%	No.	%	No.	%	No.	%	
Agricultural Implements	34	63	18	33	52	96	2	4	54
Automobile and Bicycle Factories	32	68	13	28	45	96	2	4	47
Bakeries	17	61	9	32	26	93	2	7	28
Basket Factories	4	100	..	..	4	100	..	..	4
Bolt, Nut and Screw Works	6	75	2	25	8	100	..	..	8
Boot and Shoe Factories	285	77	72	20	357	97	11	3	368
Bottling Works	1	100	..	..	1	100	..	..	1
Breweries	2	67	1	33	3	100	..	..	3
Broom Factories	4	67	1	17	5	84	1	16	6
Brush Factories	4	67	2	33	6	100	..	..	6
Candle Factories	4	67	2	33	6	100	..	..	6
Candy Factories	27	67	12	30	39	97	1	3	40
Canning Works	4	66	1	17	5	83	1	17	6
Car Houses	12	39	14	45	26	84	5	16	31
Car Works	43	70	17	28	60	98	1	2	61
Carpet Mills	82	59	50	36	132	96	7	5	139
Carriage Factories	61	69	22	25	83	94	5	6	88
Celluloid (Pyroxylin Plastic)	36	55	17	26	58	81	12	19	65
Cement and Plaster Works	1	50	..	..	1	50	1	50	2
Cereal Mills	17	63	6	22	23	85	4	15	27
Chemical and White Lead	26	55	19	40	45	95	2	5	47
Clothing Factories	168	74	54	24	222	98	5	2	227
Coffee and Spice Mills	21	70	9	30	30	100	..	..	30
Coffin Factories	19	76	5	20	24	96	1	4	25
Cold Storage	2	50	2	50	4	100	..	..	4
Cooperage Plants	34	55	20	32	54	87	8	13	62
Cordage Works	156	69	62	27	218	96	8	4	226
Cork Factories	1	33	..	..	1	33	2	66	3
Cotton Ginnery	8	80	2	20	10	100	..	..	10
Cotton Mills	2110	60	1370	39	3480	99	46	1	3526
Cotton Mill Warehouses	58	44	59	45	117	89	13	12	131
Cotton Seed Oil Mills	22	50	14	32	36	82	8	18	44
Cutlery and Hardware	5	56	3	33	8	89	1	11	9
Department Stores	177	79	41	18	218	97	7	3	225
Distilleries	4	80	1	20	5	100	..	..	5
Drug Houses	79	82	13	14	92	96	4	4	96
Dry Cleaning Establishments	1	100	..	..	1	100	..	..	1

Table No. 9—Continued.

	Extinguished Fire.		Held Fire in Check.		Total Satisfactory.		Unsatisfactory.		Total No. of Fires.
	No.	%	No.	%	No.	%	No.	%	
Dyeing and Bleaching	61	50	55	45	116	95	7	5	123
Electrical Appliances	64	79	15	19	79	98	2	2	81
Electric Light and Power Plants	2	50	1	25	3	75	1	25	4
Elevators, Grain	13	36	11	30	24	66	12	34	36
Excelsior Factories	11	79	2	14	13	93	1	7	14
Fertilizer Factories	8	50	6	37	14	87	2	13	16
Flax and Linen Mills	11	42	15	58	26	100	..	..	26
Flour and Grist Mills	22	54	13	32	35	86	6	14	41
Forge and Smithy	8	73	3	27	11	100	..	..	11
Foundries	56	51	49	44	105	95	5	5	110
Furniture Factories	229	63	97	27	326	90	36	10	362
Garages	6	60	4	40	10	100	..	..	10
Gas Works	1	100	..	..	1	100	..	..	1
Glass Works	18	75	4	17	22	92	2	8	24
Glove Works	2	100	..	..	2	100	..	..	2
Glue Factories	2	40	1	20	3	60	2	40	5
Harness and Fancy Leather	25	86	4	14	29	100	..	..	29
Hat, Fur	22	69	7	22	29	91	3	9	32
Hat, Straw	3	37	5	63	8	100	..	..	8
Ice Factories	1	100	..	..	1	100	..	..	1
Incandescent Lamp Factories	9	69	4	31	13	100	..	..	13
Insulated Wire Factories	16	73	6	27	22	100	..	..	22
Jewelry Factories	49	82	8	13	57	95	3	5	60
Knitting Mills, Cop Yarn	26	57	15	33	41	90	5	10	46
Knitting Mills, Full Process	284	66	126	29	410	95	22	5	432
Laundries	13	52	11	44	24	96	1	4	25
Lead Pencil Factories	8	73	3	27	11	100	..	..	11
Linseed Oil Works	9	75	3	25	12	100	..	..	12
Machine Shops	89	64	44	31	133	95	7	5	140
Match Factories	35	71	10	20	45	91	4	9	49
Mattress Factories	107	75	33	23	140	98	2	2	142
Mercantile	279	77	73	20	352	97	10	3	362
Metal Workers	272	64	134	31	406	95	21	5	427
Miscellaneous	171	70	68	27	239	97	9	3	248
Morocco Leather Works	4	27	8	53	12	80	3	20	15
Motion Picture Theatres	2	40	3	60	5	100	..	..	5
Musical Instrument Factories	53	69	21	27	74	96	3	4	77
Oil Clothing Factories	5	63	3	37	8	100	..	..	8
Oilcloth and Linoleum Works	17	33	20	39	37	72	14	28	51
Oil Refineries	2	40	3	60	5	100	..	..	5
Packing House and Slaughter	20	77	6	23	26	100	..	..	26
Paint and Color Works	73	78	18	19	91	97	3	3	94
Paper Box and Papeterie	46	77	13	21	59	98	1	2	60
Paper Mills	143	53	95	36	238	89	28	11	266
Patent Leather Works	4	40	5	50	9	90	1	10	10
Picture Frame Factories	21	64	8	24	29	88	4	12	33
Potteries	22	61	12	33	34	94	2	6	36
Printing and Lithographing	200	77	46	18	246	95	13	5	259
Pulp, Miscellaneous	5	42	5	42	10	84	2	17	12
Pulp, Soda	1	20	1	20	2	40	3	60	5
Pulp, Sulphite	11	44	9	36	20	80	5	20	25
Restaurants	4	100	..	..	4	100	..	..	4
Rice Mills	..	..	1	100	1	100	..	..	1
Rolling, Wire and Tube Works	11	42	14	54	25	96	1	4	26
Roofing Works	5	42	7	58	12	100	..	..	12
Rubber Cloth Factories	7	54	6	46	13	100	..	..	13

	Extinguished Fire.		Held Fire in Check.		Total Satisfactory.		Unsatisfactory.		Total No. of Fires.
	No.	%	No.	%	No.	%	No.	%	
Rubber Reclaiming Works	3	50	2	40	5	90	1	10	6
Rubber Works	47	52	37	41	84	93	6	7	90
Saw and Planing Mills	53	46	36	31	89	77	26	23	115
Shirt Factories	19	79	5	21	24	100	..	..	24
Shoddy Mills	70	59	36	31	106	90	12	10	118
Silk Mills	18	58	10	32	28	90	3	10	31
Skin Mills	2	67	1	33	3	100	..	..	3
Soap Mills	13	81	2	13	15	94	1	6	16
Stamping and Sheet Metal Works	21	55	12	32	33	87	5	13	38
Starch and Glucose Mills	8	53	2	13	10	66	5	34	15
Sugar Refining	8	67	4	33	12	100	..	..	12
Tanneries	15	47	13	41	28	88	4	12	32
Tenant Manufacturing	160	69	61	26	221	95	12	5	233
Theatres	19	79	4	17	23	96	1	4	24
Tobacco Factories	27	64	14	33	41	97	1	3	42
Varnish Works	3	75	..	..	3	75	1	25	4
Wall Paper Factories	7	70	1	10	8	80	2	20	10
Warehouses	51	73	16	23	67	96	3	4	70
Waste and Batting Mills	129	71	47	26	176	97	6	3	182
Weaving Mills	56	61	33	36	89	97	3	3	92
Whip Factories	3	100	..	..	3	100	..	..	3
Window Shade Factories	4	80	..	..	4	80	1	20	5
Woodworkers, Class A*	71	53	43	32	114	85	19	15	133
Woodworkers, Class B*	63	46	60	44	123	90	14	10	137
Woodworkers, Class C*	77	60	44	34	121	95	7	5	128
Woodworkers, Class D*	43	52	29	35	72	87	11	13	83
Woodworkers, Class E*	34	56	25	41	59	97	2	3	61
Woodworkers, Class F*	19	66	7	24	26	90	3	10	29
Woodworkers, Miscellaneous	1	100	..	..	1	100	..	..	1
Woolen Mills	520	69	189	25	709	94	43	6	752
Woolen Mill Storehouses	14	70	5	25	19	95	1	5	20
Worsted Mills	17	40	16	38	33	78	9	22	42
Total Sprinkler Fires	7750	63.6	3821	31.4	11571	95.0	609	5.0	12180

***Note.**— The Woodworkers are classed as follows:

Class A. Planing Mills; interior woodwork, builders supplies (including veneer works).

Class B. Box Factories. (Including cigar boxes.)

Class C. Miscellaneous Woodworkers. (Steam power) tenant woodworkers, (also woodworkers where there is a lack of detailed information as to class).

Class D. Sash, Door and Blind Factories.

Class E. Hard Wood Turning. (Wheels, pipes, novelties, bobbins, spools, etc., last and wood heel factories).

Class F. Pails and Woodenware. (Plates, wooden bowls, tubs, etc.).

Table No. 10.

Classification of Unsatisfactory Sprinkler Fires by Occupancies.

	Water shut off sprinklers.	Gen. defective equipment and unsprinklered portions.	Defective water supply or supplies.	Sprinkler system crippled due to freezing.	Slow operation of dry system or defective dry valve.	Slow or defective operation of high test heads.	Faulty building construction, concealed space, vertical openings.	Obstruction to distribution.	Hazard of occupancy too severe for average sprinkler equipment.	Explosion crippled sprinkler system.	Exposure or conflagration.	Miscellaneous.	Not classified.	Total.
Agricultural Implements.	1	..	..	..	..	..	..	..	1	..	..	..	..	2
Automobile and Bicycle..	1	..	..	..	..	..	..	..	..	..	1	..	..	2
Bakeries	..	1	..	..	..	..	..	..	..	..	..	1	..	2
Boot and Shoe Factories .	..	1	2	..	..	1	..	..	..	2	5	..	..	11
Broom Factory	1	..	..	..	..	..	..	..	..	..	..	..	..	1
Candy Factories	..	..	..	..	..	..	1	..	..	..	..	..	..	1
Canning Factories.....	..	..	..	..	..	..	..	..	..	..	1	..	..	1
Car Houses.....	1	1	1	..	1	..	..	1	..	..	..	..	..	5
Car Works.....	..	..	..	..	..	..	..	1	..	..	..	..	..	1
Carpet Mills.....	2	1	3	..	..	..	..	1	..	..	..	..	..	7
Carriage Factories	..	1	2	..	1	..	..	..	..	..	1	..	..	5
Celluloid (Pyroxylin) ...	..	..	1	..	1	..	1	..	6	2	1	..	..	12
Cement and Plaster Works	..	..	..	..	1	..	..	..	..	..	..	..	..	1
Cereal Mills.....	..	2	1	..	..	..	..	..	..	1	..	..	..	4
Chemical and White Lead.	1	..	..	..	..	..	..	..	..	1	..	..	..	2
Clothing Factories.....	2	..	1	..	..	..	1	1	..	..	..	..	..	5
Coffin Factories.....	..	..	..	1	..	..	..	..	..	..	..	..	..	1
Cork Factories.....	1	..	..	..	..	..	..	..	..	1	..	..	..	2
Cooperage Plants	1	3	..	..	..	1	..	2	..	..	1	..	..	8
Cordage Works.....	2	3	..	..	..	..	..	2	..	..	..	..	1	8
Cotton Mills.....	17	11	6	..	..	1	4	1	..	..	..	2	4	46
Cotton Warehouses	6	..	2	..	..	..	1	3	1	..	..	1	..	14
Cotton Seed Oil Mills	1	2	2	..	..	..	..	..	..	..	..	2	1	8
Cutlery and Hardware ...	1	..	..	..	..	..	..	..	..	..	..	..	..	1
Department Stores.....	3	1	..	..	..	..	..	..	..	..	2	..	1	7
Drug Houses	..	..	..	..	..	..	..	..	..	..	3	1	..	4
Dyeing and Bleaching....	2	1	1	..	..	1	..	..	..	..	1	..	1	7
Electrical Appliances	1	..	1	..	..	..	..	..	..	..	..	..	..	2
Electric Light and Power Plants.....	..	1	..	..	..	..	..	..	..	..	..	..	..	1
Elevators.....	..	3	2	..	1	..	1	..	1	1	2	..	1	12
Excelsior Factories	..	..	1	..	..	..	..	..	..	..	..	..	..	1
Fertilizer Works.....	1	..	..	..	1	..	..	..	..	..	..	..	..	2
Flour and Grist Mills	..	1	..	..	..	..	1	..	..	2	2	..	..	6
Foundries.....	4	..	1	..	..	..	..	..	..	..	..	..	..	5
Furniture Factories.....	6	10	2	3	..	..	2	5	6	..	2	..	..	36
Glass Works.....	..	..	..	..	..	..	..	..	..	..	..	..	2	2
Glue Factories.....	1	..	..	..	..	..	..	..	1	..	..	..	..	2
Hat, Fur	1	1	..	..	1	..	..	..	..	..	..	..	..	3
Jewelry Factories.....	2	1	..	..	..	..	..	..	..	..	..	..	..	3
Knitting, Cop Yarn.....	..	1	3	..	..	..	..	..	..	1	..	..	..	5
Knitting, Full Process ...	6	8	5	1	1	..	..	..	..	1	..	..	..	22
Laundries.....	1	..	..	..	..	..	..	..	..	..	..	..	..	1
Machine Shops.....	4	2	..	..	..	..	..	..	..	1	..	..	..	7
Match Factories	2	..	..	..	..	..	..	..	1	..	..	1	..	4
Mattress Factories.....	1	1	..	..	..	..	..	..	..	..	..	..	..	2
Mercantile	4	1	..	1	..	..	..	..	..	..	4	..	..	10

	Water shut off sprinklers.	Gen. defective equipment and unsprinklered portions.	Defective water supply or supplies.	Sprinkler system crippled due to freezing.	Slow operation of dry system or defective dry valve.	Slow or defective operation of high test heads.	Faulty building construction, concealed space, vertical openings.	Obstruction to distribution.	Hazard of occupancy too severe for average sprinkler equipment.	Explosion crippled sprinkler system.	Exposure or conflagration.	Miscellaneous.	Not classified.	Total.
Metal Workers	8	6	2	..	..	..	..	..	..	1	2	1	1	21
Miscellaneous	2	..	1	..	1	..	1	..	1	..	3	..	..	9
Morocco Leather Works	..	2	..	..	..	..	1	..	..	..	..	..	..	3
Musical Instruments	..	2	..	..	..	..	..	..	..	..	1	..	..	3
Oilcloth and Linoleum Works	..	2	..	..	..	..	1	..	11	..	..	..	..	14
Paint and Color Works	1	..	1	..	..	..	1	..	..	..	..	..	..	3
Paper Box and Papeterie	..	1	..	..	..	..	..	..	..	..	..	..	..	1
Paper Mills	3	13	3	2	..	..	..	..	..	..	2	3	2	28
Patent Leather Works	..	..	..	..	..	..	1	..	..	..	..	..	..	1
Picture Frame Factories	1	2	..	..	..	..	..	1	..	..	..	..	..	4
Potteries	..	..	..	1	..	..	..	..	..	1	..	..	..	2
Printing and Lithographing	4	4	1	..	..	..	..	..	..	..	3	1	..	13
Pulp, Miscellaneous	1	1	..	..	..	..	..	..	..	..	..	..	..	2
Pulp, Soda	2	1	..	..	..	..	..	..	..	..	..	..	..	3
Pulp, Sulphite	3	..	..	..	1	1	..	..	..	..	..	..	..	5
Rolling, Wire and Tube Works	..	..	..	..	..	..	..	..	..	..	..	..	1	1
Rubber Works	2	..	..	1	..	..	..	..	2	1	..	..	..	6
Rubber Reclaiming	..	..	..	..	..	..	1	..	..	..	..	..	..	1
Saw and Planing Mills	3	5	1	..	3	1	5	2	..	..	4	..	2	26
Shoddy Mills	4	1	5	..	..	2	..	..	..	..	..	..	..	12
Silk Mills	1	1	..	..	..	..	..	..	..	1	..	..	..	3
Soap Mills	..	1	..	..	..	..	..	..	..	..	..	..	..	1
Stamping and Sheet Metal Works	..	2	1	..	1	..	..	..	..	..	1	..	..	5
Starch and Glucose Mills	..	..	..	..	..	..	..	..	1	4	..	..	..	5
Tanneries	..	..	..	2	..	..	..	..	..	..	1	..	1	4
Tenant Manufacturing	1	3	2	..	..	..	1	..	..	..	5	..	..	12
Theatres	1	..	..	..	..	..	..	..	..	..	..	..	..	1
Tobacco Factories	1	..	..	..	..	..	..	..	..	..	..	..	..	1
Varnish Works	..	..	..	..	..	..	..	..	1	..	..	..	..	1
Wall Paper Factories	..	..	1	..	..	..	..	..	..	..	1	..	..	2
Warehouses	3	..	..	..	..	..	..	..	..	..	..	..	..	3
Waste and Batting Mills	..	3	1	..	..	..	..	1	..	..	..	1	..	6
Weaving Mills	1	..	1	1	..	..	..	..	..	..	..	..	..	3
Window Shade Factories	..	..	..	..	..	..	..	..	1	..	..	..	..	1
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Woodworkers, Class D*	1	5	..	1	..	..	..	..	..	..	3	1	..	11
Woodworkers, Class E*	1	..	..	..	1	..	..	..	..	..	..	..	..	2
Woodworkers, Class F*	2	..	..	..	..	..	..	1	..	..	..	..	..	3
Woolen Mills	5	13	10	1	..	1	3	..	..	..	3	3	4	43
Woolen Storehouses	..	1	..	..	..	..	..	..	..	..	..	..	..	1
Worsted Mills	1	1	2	1	..	..	..	..	..	..	..	2	2	9
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*See detailed classification of woodworkers as given in note under Table No. 9.

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Standard Rules and Requirements

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UPON RECOMMENDATION OF

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